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TABLE OF CONTENTS

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FUEL NEEDS

Of High Compression Engines

EXCERPTS FROM PAPER* BY

M. M. Roensch and J. C. Hughes

Research Supervisor — Research Engineer

Ethyl Corporation, Research Laboratories

* Paper "Evaluation of Motor Fuels for High-Compression Engines," was presented at SAE National West Coast Meeting, Los Angeles, Aug. 14, 1950. This paper will be published in full in SAE Quarterly Transactions.

This is a progress report on studies with the General Motors Research high-compression test engine, initially reported in the June, 1949 SAE Journal, pp. 17-21: "High Compression Engine Performance," by M. M. Roensch. Last year's article told how changes in compression ratio affected the high compression research engine's performance.

Since that time, changes have been made in the cylinder heads of these engines to permit better breathing, which improves power at high engine speed. This article discusses the antiknock requirements of the modified engine.

FURTHER studies with the General Motors Research high-compression test engine unfolded new facts about engine antiknock needs at high compression ratios. This phase of the work consisted of finding antiknock requirements in terms of both octane and performance number plus ratings of commercial type gasolines with the high-compression engine.

It had been ascertained that throughout the range of compression ratios under investigation the performance characteristics of the engine were representative of present production designs. Then knock-limited fuel requirements—in terms of primary reference fuel blends or of tetraethyl lead in isooctane—were determined over the speed range at each compression ratio. Fuel data are presented in terms of octane number, isooctane plus tetraethyl lead (for values in excess of 100 octane number) and in Army-Navy performance numbers.

Performance numbers both above and below 100 were evolved during the war by the Air Forces of the Army and Navy and were based on a considerable amount of experimental data. They were initially required for the expression of fuel antiknock values above 100 octane number in terms which have a linear relation to engine performance; this relationship was later applied to octane numbers below 100.

The Army and Navy chose indicated mean effective pressures at a fixed compression ratio and at a variable air consumption as their measure of engine performance; but data in this work indicate that performance numbers have a sensibly linear relationship to compression ratio. Since some knock-limited fuel requirements discussed here are below 100 octane number and some above, performance numbers have seemed to be the most desirable method of expression fuel requirements.

Engine dynamometer knock ratings were obtained by the Borderline method (CRC E-4-943). The engine speed was held constant, the fuel system purged, the reference fuel inducted, and the ignition timing advanced to produce trace knock. When all test fuels had been rated at one speed, the procedure was repeated at the next speed after the engine had reached equilibrium. In all knock ratings the carburetor air temperature was maintained at 100 ± 3 F, jacket-water outlet temperature at 175 ± 2 F, and the oil-sump temperature at 180 to 200 F, depending on the engine speed.

Primary reference fuel blends in 5 octane-number increments and blends of leaded isooctane in

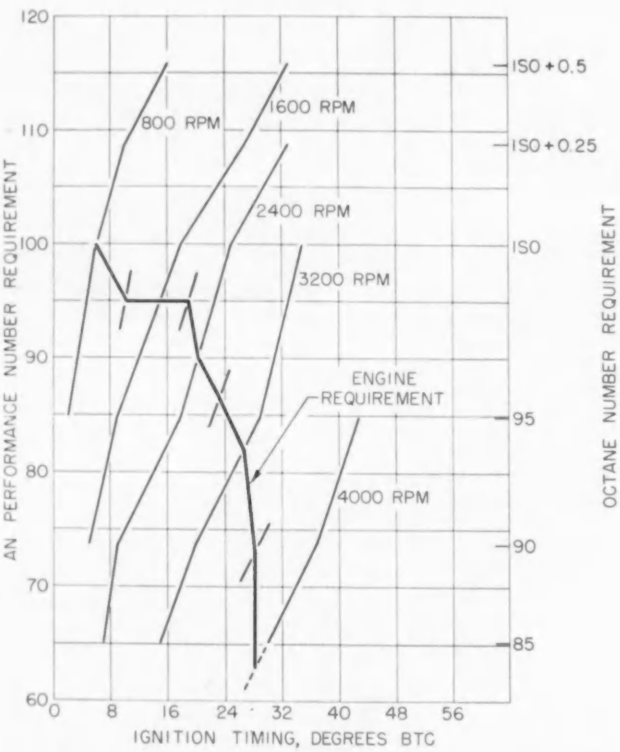


Fig. 1—Determination of the high compression engine requirement, at 10 to 1 compression ratio, using primary reference fuels

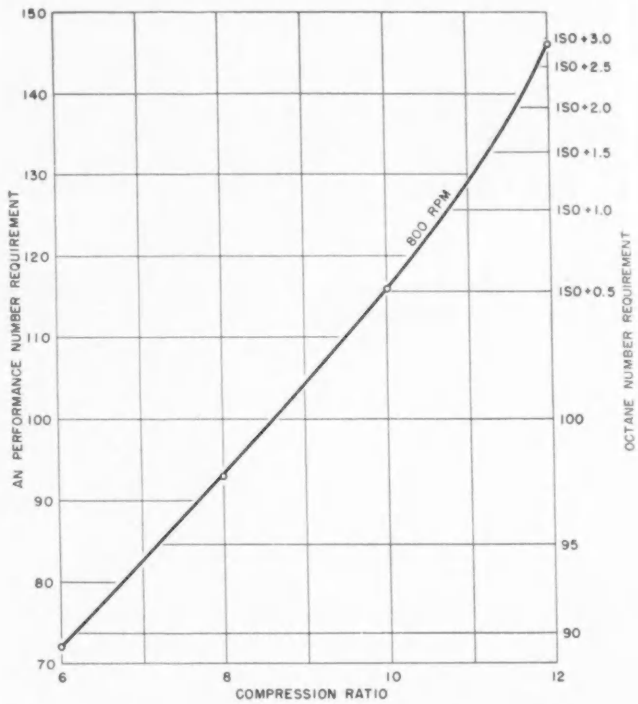


Fig. 3—Effect of compression ratio on octane and performance number requirement at maximum power spark advance

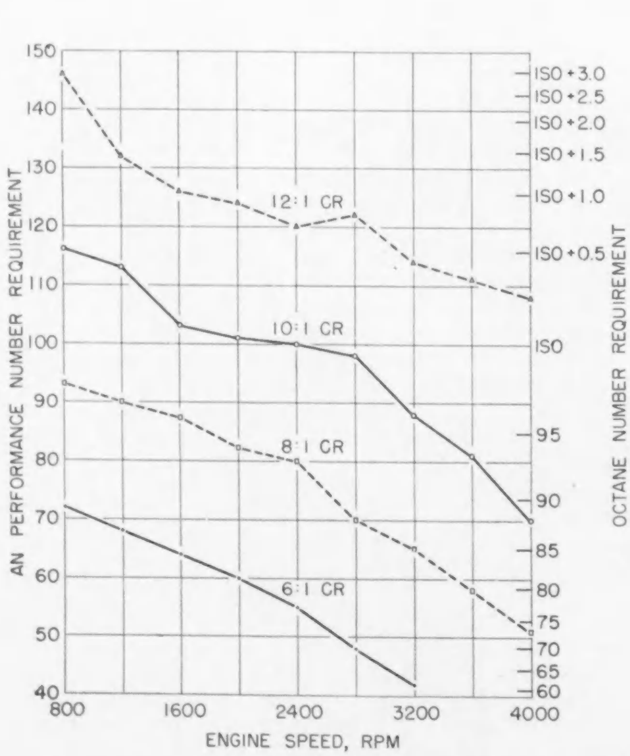


Fig. 2—Engine requirement at maximum power spark advance

0.25 ml TEL per gal increments were used to obtain a borderline framework, an example of which is shown in Fig. 1, for the 10:1 compression-ratio heads. Iso-speed lines result when ignition timings for borderline knock are plotted against Army-Navy performance number at a given engine speed. Upon this framework the ignition timings (either maximum power or any desired distributor curve) may be plotted and the performance-number requirement for each speed thereby determined.

This procedure is illustrated in Fig. 1, where the heavy solid line is the so-called normal distributor curve which indicates the engine requirement over the speed range with this ignition timing. Also, ignition timings to produce trace knock on the test fuels at the various engine speeds may be plotted in the same manner and the engine rating of these fuels thus obtained.

New Plot More Suitable

All the engine requirements and fuel ratings shown were derived from similar data. Experience has shown that this method of handling borderline knock data produces more satisfactory results than the more conventional plots of ignition timing against engine speed when dealing with the higher compression ratios and higher octane numbers, since no interpolation is necessary in the analysis of the data.

The requirement throughout the speed range is

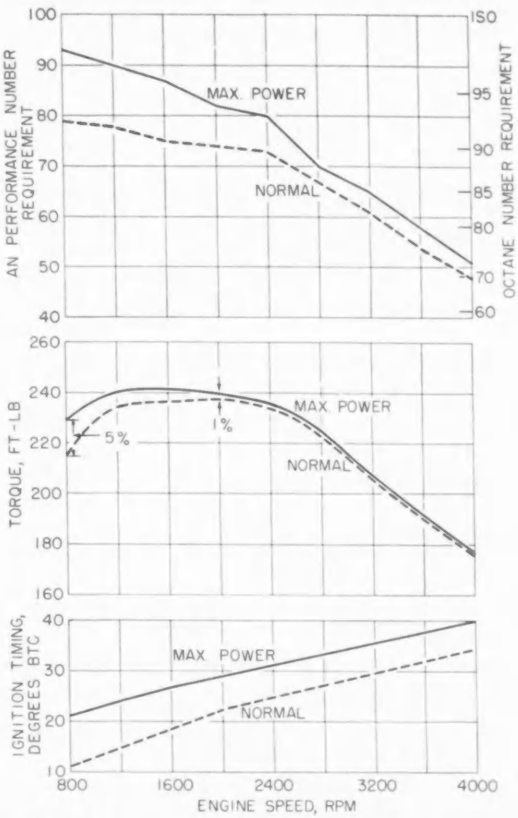


Fig. 4—Effect of normal and maximum power ignition timings on torque and performance number requirement of the high compression engine at 8 to 1 compression ratio

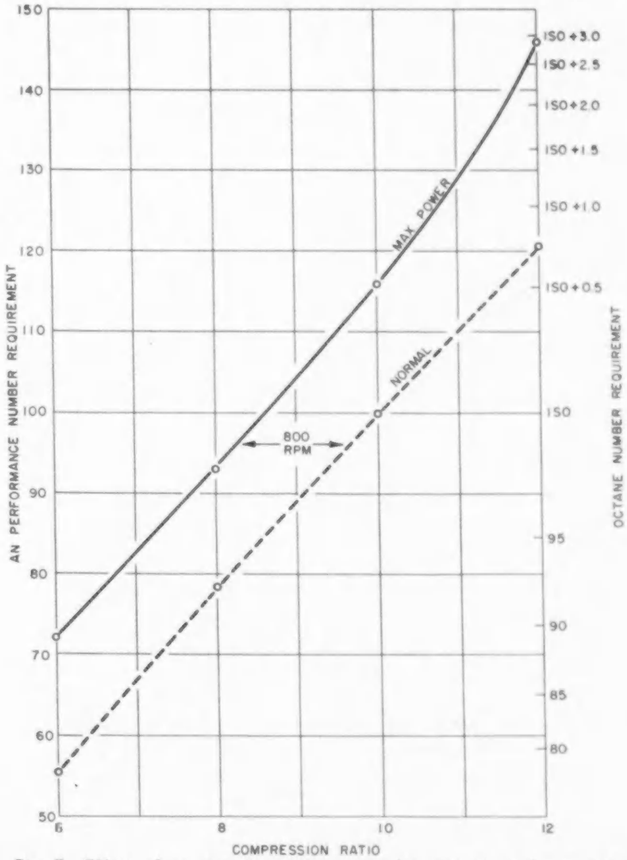


Fig. 5—Effect of compression ratio on requirement at maximum power and normal spark advance

shown in Fig. 2. The effect of compression ratio on the requirement at the speed of maximum knock is shown in Fig. 3. These data are all based on the ignition timing for maximum power with the carburetor set to give maximum power (approximately 13 to 1 air-fuel ratio). Automotive engines, however, are not usually operated at a spark advance for maximum power, but are retarded considerably at the low speeds and a lesser amount as the speed is increased.

For the purposes of comparison over the range of compression ratios being studied, an arbitrary power loss of 5% has been taken at 800 rpm, and a 1% loss from 2000 to 4000 rpm, as shown in Fig. 4. This chart shows the loss in torque when this type of distributor advance curve is used at 8 to 1 compression ratio. Also shown are the spark advance versus engine speed for maximum power and the spark advance curve for the normal distributor. The effect of this change on the requirement over the speed range is clearly shown.

With this same type of distributor setting throughout the series of compression ratios tested, the requirement is considerably reduced at the speed of maximum knock, as shown in Fig. 5. The requirement of the engine over the speed range with the modified spark advance at all ratios is shown in Fig. 6. The data shown in Fig. 6 indicate the potential value of an engine of this type to study fuels either for present engines, or for possible future high-compression engines. The compression ratio can be selected to evaluate the fuels under investigation without the necessity of resorting to abnormal ignition timings.

Some indication of both the desirability and the value of this type of investigation for fuel development work is indicated by a series of tests run at

Table 1—Fuel Inspection Data

Fuel	Sensitive A	Sensitive B	Insensitive C	Balanced Fuel
Fuel No.	202-49	492-48	638-48	686-48
Vapor Pressure	8.2	9.2	8.0	7.8
API Gravity	55.6	57.3	66.2	54.5
Volatility:				
Initial	94	92	93	98
10%	134	122	139	134
50%	242	234	241	229
90%	372	356	358	352
Octane Number, Clear				
ASTM Research	91.6	87.6	79.0	84.7
ASTM Motor	79.8	78.8	80.1	80.2
Octane Number, 3 ml TEL				
ASTM Research	97.0	95.2	93.0	97.1
ASTM Motor	84.2	85.8	93.5	91.3
Sulfur, % by Weight	0.084	0.078	0.007	0.010

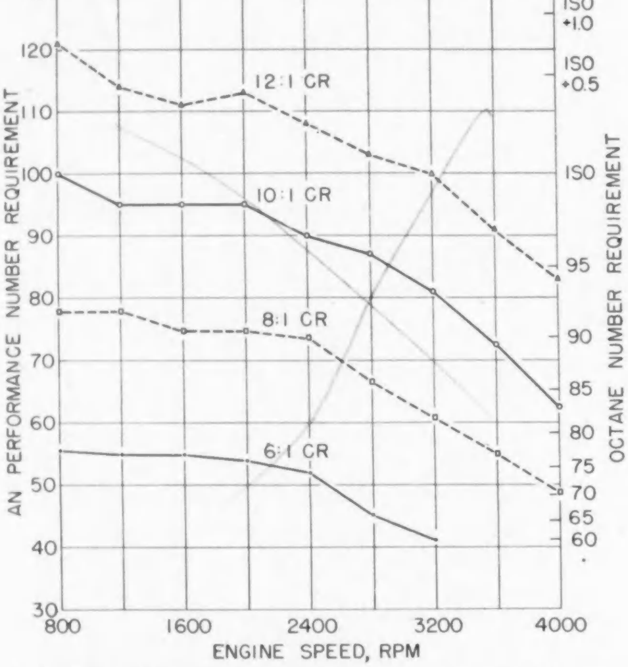


Fig. 6—The high compression research engine's octane and performance number requirement at normal ignition timing

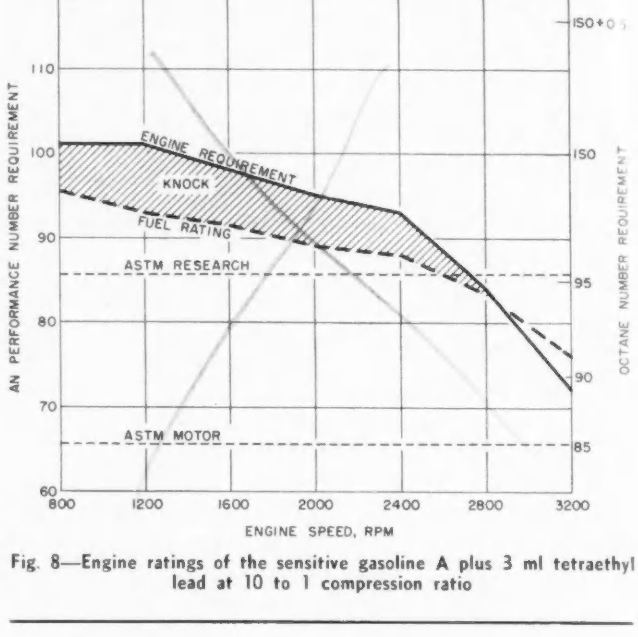


Fig. 8—Engine ratings of the sensitive gasoline A plus 3 ml tetraethyl lead at 10 to 1 compression ratio

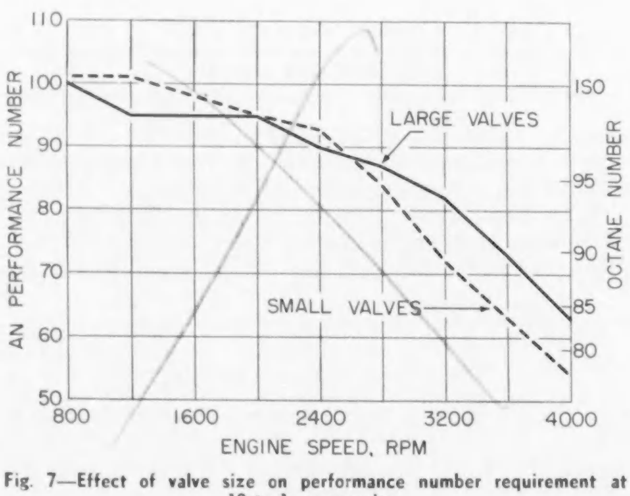


Fig. 7—Effect of valve size on performance number requirement at 10 to 1 compression

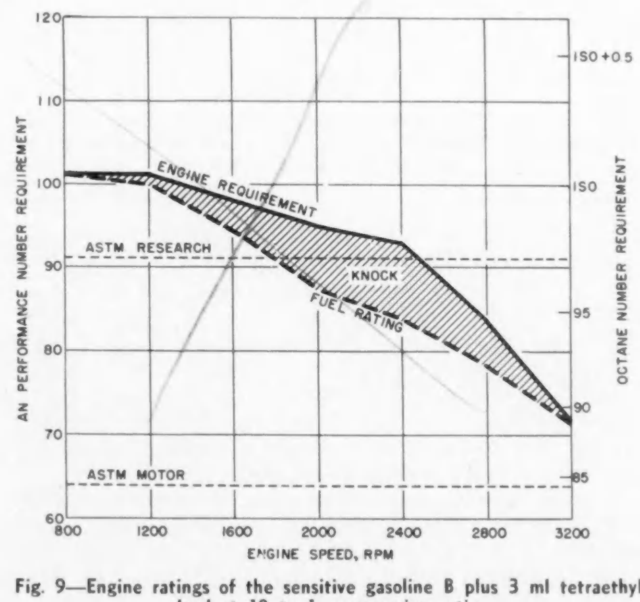


Fig. 9—Engine ratings of the sensitive gasoline B plus 3 ml tetraethyl lead at 10 to 1 compression ratio

10 to 1 compression ratio. The 10 to 1 heads used for this part of the investigation were the original design with the small intake and exhaust valves. First a comparison was made under the same test conditions to determine the requirement of both the large and small valve designs in the 10 to 1 compression-ratio cylinder heads, so as to indicate how the improved volumetric efficiency might affect the engine requirement. This comparison is shown in Fig. 7. There is little difference in requirement up to 2800 rpm, but the requirement of the heads fitted with the larger valves is higher by 10 performance numbers at 3200 rpm. These heads gave an increase of 8 bhp at 3200 rpm, and this increase indicates the reason for the higher requirement.

The gasolines selected to be rated were two sensitive gasolines, one insensitive gasoline, and one a balanced gasoline prepared by the Ethyl Research Laboratories. The inspection data on these gasolines are shown in Table 1. These gasolines were tested clear, and with several different concentrations of tetraethyl lead. The data, however, are confined to the blends containing 3.0 ml TEL per gallon because these represent the highest permissible lead concentrations in automotive gasolines.

The gasolines were rated in the engine at con-

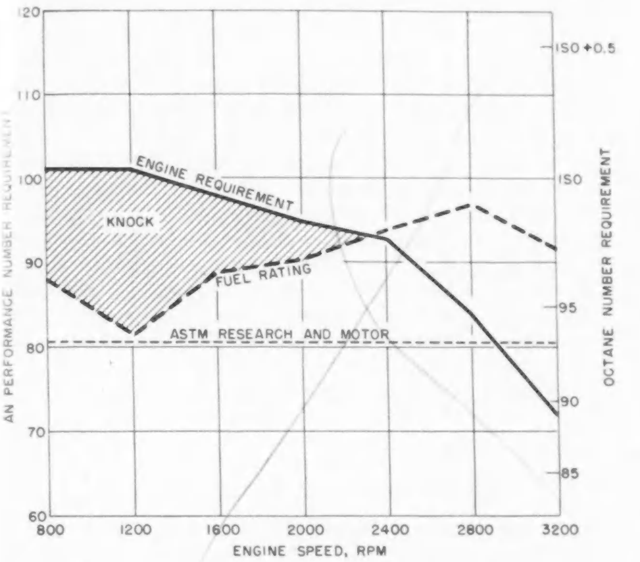


Fig. 10—Engine ratings of insensitive gasoline C plus 3 ml tetraethyl lead at 10 to 1 compression ratio

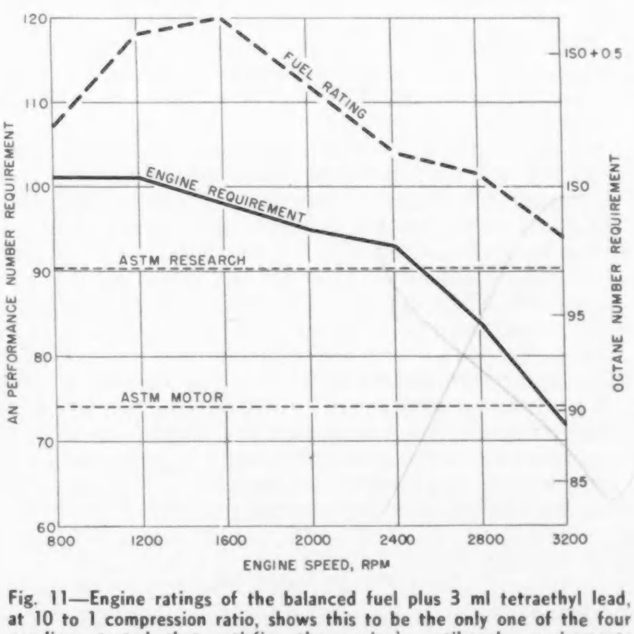


Fig. 11—Engine ratings of the balanced fuel plus 3 ml tetraethyl lead, at 10 to 1 compression ratio, shows this to be the only one of the four gasolines tested that satisfies the engine's antiknock requirements throughout the speed range

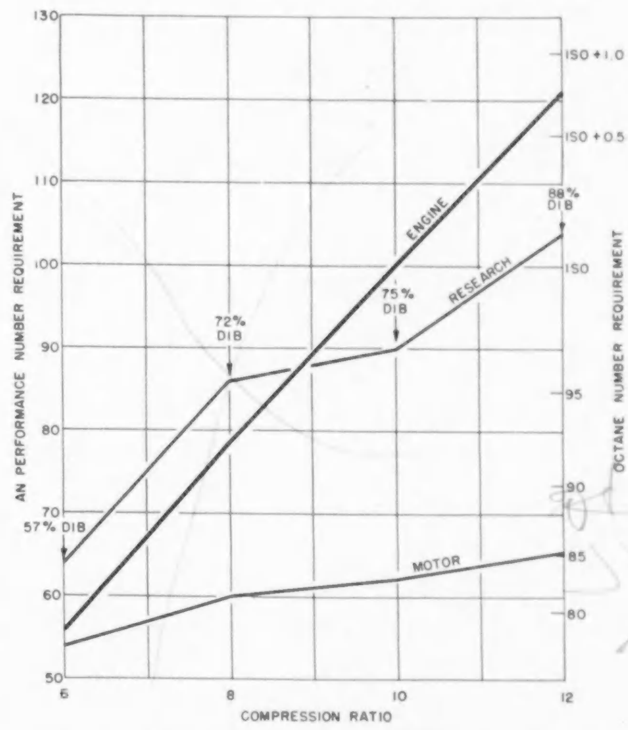


Fig. 12—Effect of compression ratio on requirement with diisobutylene-blends at 800 rpm

stant speed on the engine dynamometer against primary reference fuels, and were compared to the engine requirement on primary reference fuels, based on spark advance for the normal distributor curve. The relationship of the fuel ratings compared to the engine requirement gives a very good indication of the fuel performance over the entire speed range.

It should be emphasized that the commercial blending stocks, represented by gasolines A, B, and C, are not to be taken as representative of all gasolines prepared by the processes involved, but are used only to illustrate how some of the antiknock characteristics may be evaluated by using a suitable test engine. Fig. 8 shows the engine rating of the sensitive gasoline A, and indicates how it satisfies the engine requirement at low and high speeds but fails to satisfy the engine by 9 performance numbers in the maximum-torque (medium speed) range. In other words, if this gasoline were run in the engine with the normal distributor advance, it would knock throughout the intermediate speed range.

How Fuels Satisfied Engine

In this and subsequent charts on fuels, the Research and Motor method ratings for each of the fuels are shown as horizontal lines on the figure corresponding to the engine rating of that particular fuel.

Fig. 9 shows a similar comparison of the sensitive gasoline B, which fails to satisfy the engine at low and intermediate speeds. Fig. 10 shows the performance of an insensitive gasoline C, which fails to satisfy the engine by about 10 performance numbers at 1200 rpm, but is satisfactory at speeds over 2400. Fig. 11 gives the performance of the balanced fuel, which considerably exceeds the engine requirement throughout the speed range, even though the Research and Motor method ratings are not significantly different from some of the commercial fuels. These data illustrate the fact that in multicylinder engines the antiknock performance of certain fuels is difficult to predict on the basis of their Research and Motor method ratings.

The use of sensitive reference materials, such as diisobutylene and toluene blended with heptane,

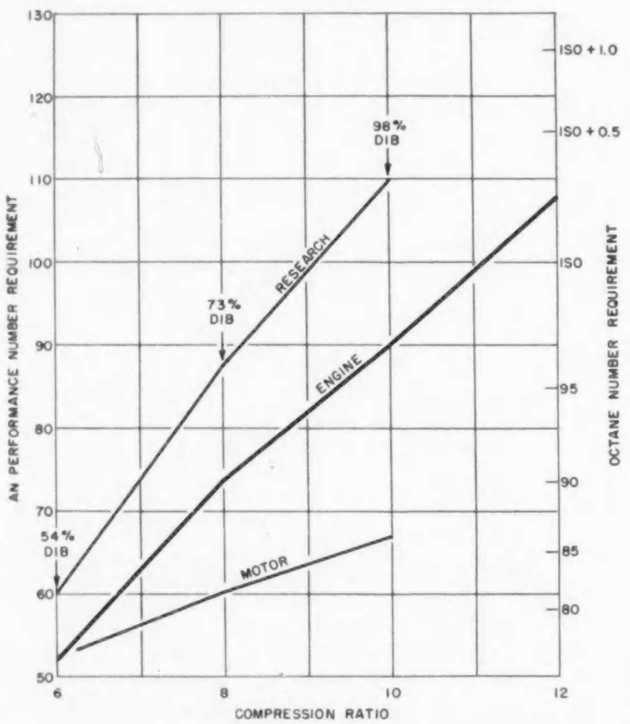


Fig. 13—Effect of compression ratio on requirement with diisobutylene-heptane blends at 2400 rpm

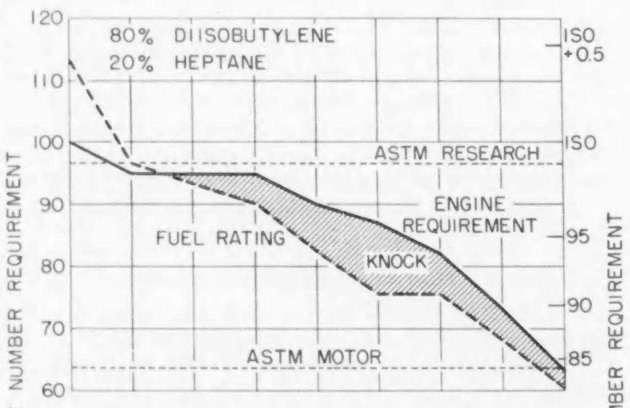


Fig. 14—Comparative engine ratings of diisobutylene-heptane and toluene-heptane blends at 10 to 1 compression ratio

has been suggested as a means of simulating commercial fuels. Diisobutylene-heptane blends have also been used for expressing engine severity. An engine which rates the fuels at or near their Motor method ratings is considered to be severe and when it rates them near the Research level or above it, it is considered to be mild.

The ability of this engine to utilize sensitive fuels, or its severity at various compression ratios, was determined by finding the blend of diisobutylene and heptane that would give trace knock at each test condition. Then the engine rating of this blend was compared with the ASTM Research and Motor method ratings of the same blend. The percent of diisobutylene required to satisfy the engine at each condition is shown in Figs. 12 and 13 immediately above the Research rating of the blend.

Higher Compression Imparts Mildness

The effect of both compression ratio and engine speed on severity are shown in Figs. 12 and 13. These data indicate that the engine becomes milder as compression ratio is increased at all engine speeds. The fact that the engine becomes milder as compression ratio is increased is important in view of the present refining trends toward gasolines of greater sensivity. This means that the future high compression engine designs will tend to ultilize full benefit of the future gasolines.

However, it should be noted that as speed is increased, the engine becomes more severe at any one compression ratio. These data indicate that the diisobutylene-heptane blends may be useful to engine manufacturers in studying the factors affecting engine severity.

A comparison between the diisobutylene-heptane blend and toluene-heptane blend, of approximately the same Motor and Research rating is shown in Fig. 14, which indicates that the engine rates these two blends quite differently. These data show that 80% toluene almost satisfied the engine up to 2800 rpm and is knock-free above that speed, while the diisobutylene is knock-free only at low speeds and knocks throughout the speed range above 2000 rpm.

Fuel Job Clarified

These various commercial type gasolines and toluene-heptane and diisobutylene-heptane blends were used primarily to show that the problem of satisfying high-compression engines is no different basically from that of satisfying present production engines. Both the automotive engine designer and the fuel technologist must continue to work on their respective problems; the former to find mechanical octane numbers to permit the use of high-compression engines without unduly increasing the octane number requirement, and the latter to find economically feasible blends of hydrocarbons that give satisfactory antiknock performance.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

TURBOJET ENGINES —Service Experience

EXCERPTS FROM PAPER* BY

John W. Bailey, Head of Engineering Service Section, Allison Division, GMC

* Paper, "Turbojet Engines—Service Experience," was presented at the SAE National Aeronautic Meeting, New York City, April 17, 1950.

WHEN the jet engine program was first started in this country, which was toward the end of World War II, our military services wanted a "jet engine air force" in the shortest possible time. To achieve this end it was necessary to put a new type of engine, on which little development and production experience was available, into production "regardless of unknowns." Normally, such a new product would be placed in production only after we had sufficient time to "flight test out the bugs." The need for improvements in design was recognized at the very start of the program and design changes, which of necessity were only ideas, were incorporated. The proof of such ideas, on which there was little applicable experience, had to come from service operation.

Allison J33 and J35 engines have accumulated nearly one-half million flight hours in the past five years. During this time, even under the unusual development circumstances, it has progressed from a highly experimental project to a dependable aircraft powerplant. While the service life has been increased more than 1700% on the J33 and 1200% on the J35, even greater progress and higher current average times could be shown had the development of the engine progressed in a more normal fashion.

In one-half million flight hours, service problems were to be expected on these engines, which were placed in production with such "built-in unknowns" —we have not been disappointed. The turbojet has inherently critical design problems, which, of necessity, have required the statistics of service experience to develop adequate solutions.

J33 Service Problems

Cast Turbine Bucket—It was not until early 1948 that the cast turbine bucket, used only on the J33 series, was showing up in service as one of the major reasons for engine removal, due perhaps to the early low allowable time, and the fact that other parts on the earlier engines appeared as more serious trouble points. As these other problems were corrected and more service experience obtained, the turbine bucket on the higher rated engines of later type became a major problem. The casting process, with its variables of material uniformity, had been selected for turbine buckets because of the importance, from a production standpoint, of the development of casting techniques for such an application. Laboratory, endurance, and qualification tests did not point out the full aspects of the turbine bucket problem and it was only through service experience that the need for accelerated development of such a part was shown. Through this development, initiated by a service problem, Allison has gained an extensive background on the various processing methods of such a highly stressed, high-temperature part, which undoubtedly for some period will be the principal limiting factor on any turbine engine.

This experience has also produced turbine bucket and turbine wheel design in which individual buckets can be easily replaced by maintenance activities with the minimum of tools or equipment and only tail cone removal. In many aircraft this does not even require engine removal.

When the individual bucket replacement program, now under evaluation by the military services in actual squadrons, has been fully approved for all activities, the average time between overhaul for higher rated engines will be greatly extended.

Nozzle Diaphragm—The nozzle diaphragm assembly is the second most serious service problem as a cause for engine removal, not in regard to its frequency but primarily because of the complexity of permanent correction. The difficulties have been primarily distortion and some blade cracking plus blade damage from foreign material. This assembly, being subject to extremes in temperature and other associated temperature differential problems, will undoubtedly require continued design investigation to improve its durability materially beyond 500 hr. Design changes made to date have greatly improved its service life and have still maintained retroactive interchangeability in the early J33 type of engines.

Accessory Drive—The problems concerning the accessory drive assembly have been of only a minor

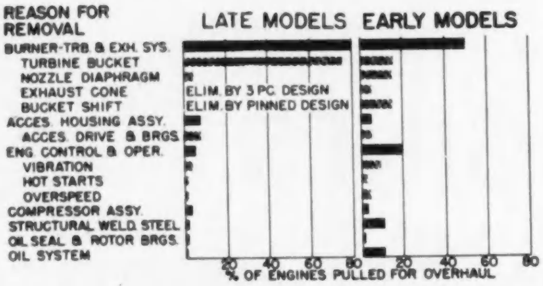


Fig. 1—J33 engines removed for overhaul—engine troubles only

nature and involve primary lubrication problems at certain critical bearing locations. These problems have been corrected, for the most part, by such design change as could be provided and still maintain interchangeability with earlier models. While engines being built today incorporate these improvements, the engine removal summary includes, primarily, engines of early configuration, which do not incorporate such changes.

Engine Control and Operation—Engine removals in this category are principally those which are indefinite as to cause by the particular operating activity and are in many cases not indicative of engine failure but rather of errors in operating technique. The comparison of the early and later types of engines removed from this category shows the improvement brought about by the automatic fuel system incorporated in the later engine models, wherein the problem of starting is accomplished automatically and hot starts and overspeeding practically eliminated.

The improvements incorporated in the later J33 model, in regard to the compressor assembly, structural steel parts, and oil system difficulty, are reflected in Fig. 1. For the most part, these problems involved design refinement rather than major redesign for correction.

J35 Service Problems

The J35 engine incorporates certain inherent design problems common to the axial-flow type of engine. These involve, principally, the length of the engine structure, involving problems of deflection under flight maneuver loads, a lubrication system with an inherently more difficult bearing oiling problem, and an external oil supply, which subjects the engine to greater oil contamination. With these complexities and with less development time and service experience, the J35 engine development has shown, by its rapid rate of increase in overhaul time, the benefits of previous experience in the J33 engine. The problems which have occurred in service and, in particular, those more important troubles which cause engine removal or overhaul, have certain similarity to the pattern of the J33 engine. For the most part, these have been confined to the combustion turbine section and the interrelated bearing lubrication system. Because of these design problems associated with the axial-flow engine, service experience has been even more helpful on this model than on the J33 in determining installation factors which contribute or cause engine difficulty.

Main Rotor Bearing—As shown in Fig. 2, compressor and turbine rotor bearings have been one of the principal causes for engine removal. Engines removed for such causes as vibration, general roughness, or internal noise are generally termed by the Services as being bearing failures, the verification for which can only be obtained by teardown inspection. For the most part, bearing failures have not been primary in cause but are the secondary result of marginal lubrication or engine structural deflection. Service experience has been indispensable not only in determining the point of difficulty but also in providing the data needed to correct the problem. It has also been possible to provide certain modifications to existing engines at the time of overhaul for the purpose of determining, in actual service operation, whether the proposed fix will be satisfactory in flight, thereby substantiating sometimes misleading test results. These service bearing difficulties have shown the need for a refinement in dimensional control of bearings, the configuration and antifriction treatment of bearing retainers, and the clearance requirements for bearings of the type not previously needed in commercial application.

Nozzle Diaphragm—As in all engines, the nozzle

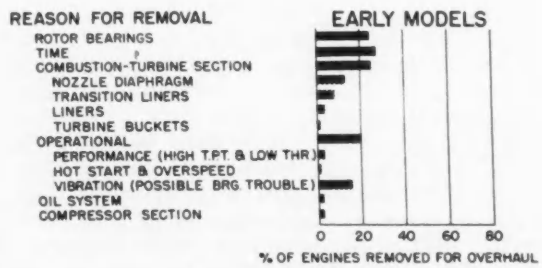


Fig. 2—J35 engines removed for overhaul—engine troubles only

diaphragm is a service problem because of temperature distribution variation and the associated distortion plus foreign material damage. Experience has shown that relaxation of crack, dent, nick, and distortion limits can be tolerated without compromising engine performance or reliability. Considerable progress has also been made in current design to eliminate much of the distortion found in the earlier types. This and similar improvements made in the turbine bucket and the burner liners have been the prime factors in increasing engine time. To keep this part completely free of distortion of foreign material damage is a difficult task but the relaxation of service rejection limits will be a large factor in extension of average engine time.

Burner Liners—Burner liners on early J35 engines required frequent inspection and replacement because of distortion and cracking. Current production types have virtually eliminated these earlier problems for at least the first 200 hr of operation. The relaxation of used-liner inspection limits, based on previous J33 and J35 service experience, has materially added to the engine utility.

Forged Turbine Buckets—Complete failure of turbine buckets in service has been virtually non-

xistent in this engine but, in order to realize full ngine life, efforts are being directed toward making ield bucket replacement possible with the minimum f tools, equipment, and engine teardown in order o replace those parts damaged by foreign material.

Operational Troubles—Engine removals in this general category are usually the result of the misinterpretation of high tailpipe temperatures and low thrust valves and errors in operating technique causing hot starts and engine overspeed. While these troubles are shown as chargeable to the engine, hot starting and engine overspeed are the only ones which are correctable through engine change. Speed-density controls, now standard production items on current models, are virtually eliminating starting and overspeed problems, except in cases where final control settings or adjustments have not been definitely established.

Service Operational Troubles

Service difficulties correctable by parts replacement in operating activities, (Figs. 3 and 4) have been generally confined to the fuel, ignition, and oil systems, and the burner-turbine-exhaust or "hot" end of the engines.

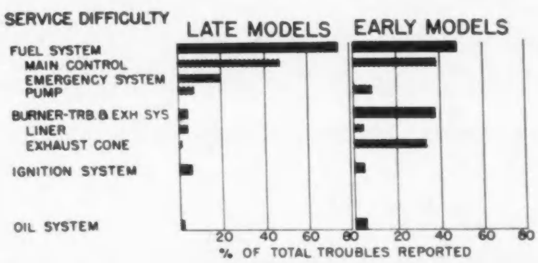


Fig. 3—Comparison of J33 service troubles not requiring engine removal

Fuel System—On the early J33 and J35 models, fuel system difficulties primarily were concerned with minor difficulties, such as leaks and schedule changes. These early engines (both J33 and J35) had common fuel systems consisting of an overspeed governor, an altitude-compensated bypass valve or barometric, and a throttle valve. In the early stages, this system operated with reasonably satisfactory results once the problems of the system were known and refinements made to improve the ability of the components to withstand contaminated fuel. This system left much to be desired in providing adequate engine protection against hot starts, which had a serious detrimental affect on engine life, in preventing altitude blowout from too rapid throttle acceleration or deceleration, and altitude-compensation stability over the wide range of jet engine flight conditions. Once the early functional problems of the controls were solved, service experience indicated the requirement for a control system which provided (a) an overspeed governor, (b) refinement in altitude compensation, (c) engine-mounted emergency fuel system, which was completely automatic in operation in the advent of main system failure, and, (d) automatic starting for the J33 to prevent errors in pilot technique and resulting hot starts.

This general system, now common to both the current production J33 and J35 engines, has operated for over two years without major difficulty. The principal problems, which are to be expected with any new system of such complexity, have been primarily in the category of refinement of control scheduling and intercontrol sequencing. The aircraft companies have been extremely critical of the system and many component rejections were made during the earlier states of production because of lack of understanding or inexperienced field adjustment. Aside from these factors, the service experience with this system has been extremely satisfactory, if we fully appreciate its complexity.

Burner Turbine and Exhaust—Field difficulties with this engine section in both models have accounted for a share of service maintenance replacement. Design changes made in the later J33 model have virtually eliminated the majority of the problems in this section of the engine. The relaxation of inspection limits has also played a great part in obtaining greater engine utility with the minimum of parts replacement. The early J35 series engines do not reflect improvements made in current production burner liners, which already have proved their durability.

Electrical System—Ignition system troubles on the J33 are confined principally to spark-plug replacement due to electrode burning. In this regard, the principal advancement in the development of spark plugs which will resist carbon formation and electrode deterioration was achieved at a USAF operating base by location modification and service test of various plug configurations until one was found which, under actual flight conditions, provided satisfactory results. Attempts to duplicate such carbon formation on test-stand operation had been practically impossible.

The J35 starter-generator difficulty primarily has been confined to brush wear. The problem of development of such a unit serving both as a starter and a generator, calling for totally different brush requirements, has been an especially difficult problem. Only through service experience has it been possible to evaluate design changes fully under the altitude and electrical load conditions encountered in service aircraft.

Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.

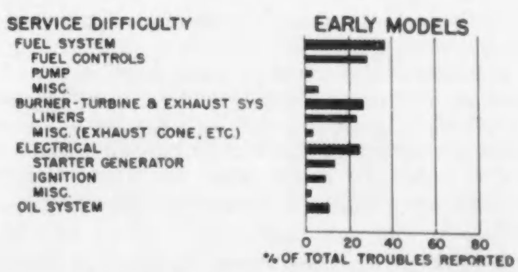


Fig. 4—Comparison of J35 service troubles not requiring engine removal

PROVING GROUND

Tests at proving ground, such as above, are under full control . . .

PROVING ground and field testing supplement rather than replace each other. Each has its place, depending on the particular application. Proving ground work is well-suited for proving a design in a closely controlled program and to iron out initial rough spots. Long-range field tests furnish refinements required for each geographical area and application.

More detailed evaluation of these types of testing brings to light these four facts:

1. Facilities such as test area and machines are better in the field, although buildings, shops, tools, and instruments are more suitable at the proving ground.
2. Proving ground testing holds the upper hand in control of men, machines, weather, facilities, and terrain.
3. Relative costs of each depend on the particular test program. Expenses for labor, machines, and fuels and lubricants generally run lower for on-the-job testing, but necessary expenses for maintaining good customer relations may offset this advantage.
4. Each method offers its own benefits. But only from the combined gains from both can the most dependable, versatile, and economical machine be evolved.

Starting with the test area as part of the test facilities, field testing must be given the nod because of its great size, variety of both terrain and weather. Only plus value here for the proving ground is its proximity to plant headquarters.

Field testing offers the timbered slopes of the Pacific Northwest, the rough Mesabi iron range, the swamps of Louisiana, and the Florida peat land. Establishing a proving ground a short distance from the plant usually is hampered by population density and high land costs.

Field testing also offers the cold with driving snow in the North, the arid desert of the West, or almost any combination of weather desired. Although wind, rain, snow and cold can be produced in proving ground test rooms, they—like substitutes for terrain—are compromises at best.

As for buildings, those on the proving ground are constructed for testing purposes; in the field, that's generally not the case. Proving ground structures fit a permanent type operation; those in the field must be temporary.

By the same token shops, tools, and instruments are more complete at the proving ground. Such things as dynamometers, strain gages, oscillographs, and other devices may be found only at the proving ground. Few mobile laboratories contain such essential equipment for field testing use. Nor are field shops equipped to repair and calibrate such instruments. Often field test personnel must rely entirely on the distributor's service organization for even the repair of tools.

Advantage swings back to the field in the matter of machines. The many sizes and variety of machines in the heavy equipment field makes it tough

. . . . **but cannot exactly duplicate the ruggedness of this Pacific Northwest slope**

BASED ON PAPER* BY

P. H. Spennetta

General Supervisor, Research Department, Caterpillar Tractor Co.

* Paper "Proving Ground Versus Field Testing," was presented at SAE National Tractor Meeting, Milwaukee, Sept. 12, 1950.

to maintain a fleet of the latest design machines at the proving ground. Often too, a problem comes up on an older machine no longer at the proving ground.

Field testing invariably offers any particular machine with attachments which may be needed, except, of course, pilot models not yet in production. In many cases the machine in the field is the very reason for the problem.

Control Tightest at Proving Ground

The timing and speed needed to find answers to problems on every model and the coordination with manufacturing required places a premium on test control. In this respect, proving ground testing leads all the way, and that includes control of men, machines, weather, facilities, and terrain.

Because of tightly-knit unions, many field test crews cannot bring their own men to operate test machines or customer machines with experimental parts. This means the manufacturer has no control over men on a field job. He has full control over men at the proving ground.

Machines are in the field to earn a profit in a productive capacity for the customer. Whether a component part is placed on the customer's machine, or a complete machine is put in his hands, his job superintendent must control the job. This applies to the type and amount of work the machines do, fuels and lubricants, service periods and methods. Even installation, inspection, and parts removal are in the job superintendent's hands.

When the customer's machine has served its purpose, it is either moved to another job or sold. Besides losing our control of field testing, we sometimes lose our complete test during such changes. The test group controls all these factors at the proving ground.

We said the field offers the ideal in weather, with almost any variety desirable. But the catch is that you can't command it when you want it. Many a lament can be heard about weather in the field. You may ship a machine many miles to that one cold spot that has had -20 F weather one month of

Fig. 1—Although field testing offers all kinds of weather, you may not get what you want when you want it. The slightly wet tester here is on the second day of an air cleaner test, over 1000 miles from headquarters. He knew this as a dry, dusty spot

every year for the last 10 years, or to that dry, sunny spot that stays warm all winter. Yet despite Weather Bureau statistics and a waiting production staff, this one time you'll find the cold spot stayed 20 F, and the sunny, dry spot had so much rain it was flooded. See Fig. 1.

Certainly the proving ground is subject to these same oddities of nature. But it may have a substitute. Almost any condition can be closely simulated in a proving ground test room under control of test personnel.

Control also is left to others as regards facilities in the field. For example, if we use shop facilities used by the public, we must wait our turn like any other customer. If fortunately we are on a job with facilities of its own, we might be classified as a nuisance. If our machine disrupts work because of poor design so that it becomes an expense to the job, we will soon be looking for another field test site.

The proving ground gives complete control because all facilities are under full supervision of the test group and nearness of proving ground to plant also helps maintain coordination.

With regard to control of terrain, all field testing must be done with completion of the job in mind. Unless the particular work being done in the field happens to fit the test, the tester finds himself in an awkward position. He has no authority to change the type of work being done. His only alternative is to move to another job that meets his needs. With no schedule or specifications to meet, proving ground personnel may set up any type of simulated job to fit the test work at hand.

Finding the most economical test depends largely on the particular problem on hand. But going into this costwise consideration are expenses for men, machines, fuels and lubricants, and facilities.

Field testing requires fewer people. The field personnel payroll is lower because the tester does not pay the machine operator. In addition to the technical staff, required in both types of testing, the proving ground needs machine operators and maintenance men. However, when the field group needs maintenance or repair work done, it often pays more for such labor in the field than the going scale at the proving ground.

But often the proving ground pays premium wages to get operators fresh from construction or field work for more accurate criticism of a particular machine's ability to handle a specific job. The field group gets this kind of labor at no cost.

No Charge For Machines in Field

Machine expenses for field testing are very modest compared to those of the proving ground. The cases are rare where an accommodating customer cannot be found who will make his machine available for a test. With enough searching, any machine, or combination of machine and attachments, is available for field testing without maintenance or ownership required.

The proving ground must have models of all current production machines to be truly effective. Different combinations of attached equipment can further increase the number of machines required. This adds up to an expensive fleet of machines being maintained at the proving ground for necessary test work.

But this is not the whole picture. Field testing incurs an expense for perpetuating good customer and distributor relations. We must keep the customer happy and also feel free to return again if the need arises. After completing the test, we replace our experimental parts with brand new ones, leaving the equipment in top condition. This may amount to replacing a major group on the machine—such as transmission or engine.

We may compare the overall machine cost by considering each method for a given test. In one case the total is the cost and upkeep of the entire

proving ground fleet minus the cost of test parts on which it partially operates. Certainly that's higher than the cost and upkeep of relatively few machines required by field testing plus the cost of promoting good relations.

Another expense borne by the proving ground, and not by the field test project, is fuel and lube costs. In the field, this is usually a part of the customer's expense, except when a special fuel or lubricant is being tested.

The proving ground test also carries the direct expense of the cost and upkeep of buildings, machines, tools, equipment in the buildings, and means of transportation to the test. These may not be direct expenses to the field test, but they are paid for indirectly. For example, instead of buying or leasing and maintaining the grounds for testing, the field group must send out a scout to find the proper test area and a cooperative machine owner. His expenses must be carried. Shipping experimental parts or a machine to the test site also is costly.

The field test also pays indirectly—and pays more—for facilities that would be at the proving ground for installation, inspection, removal, or repairs. A man must be maintained at the test site or he must pay several visits to the job if it runs for a long period. Buying the customer or distributor a meal, or replacing parts, and returning the man all swell the accumulated cost.

Examples on record show how the figures can mount. One field test of a single component part, lasting just a few weeks, ran dollar expenses into the five-figure range. Another unit test required a two-year test period and costs totalled over one-half million dollars.

Under each type of testing, costs will average out about the same over the year. But any specific test will probably be less costly by one of the two methods.

Gains from Each Type Test

Generalized comparison of benefits derived from each of the two methods means little. Proof of the pudding is analysis for a particular case. For example, take the job of assembling a group of parts on a machine to check fit and appearance. We want to do this fast and as conveniently as possible. The owner in the field has little incentive to help; he gains no direct benefits. The proving ground is more logical. It is the closest site and all the facilities are there.

We probably would not choose the proving ground to check abrasion resistance and strength of a new type tractor track shoe to be used on a future tractor design. A test of this kind probably would go to some rock quarry or the Mesabi iron range. At such location we know the track will get the severest punishment and the user will benefit. Time is no handicap, the user will bear all machine operator, fuels, and lubricants costs, and the part is easy to remove.

The decision in each case depends considerably on the benefits each method offers. For the proving ground, they are:

1. Closeness to plant headquarters permits use of all plan facilities and allows fast action, first-hand observation, and easy, inexpensive, and complete communication. It also simplifies transportation problems.
2. Complete test-group control of the job permits fast and easy changes, plus ability to run accelerated or simulated tests.
3. The work can be well planned, and all facilities—including manpower—used to best advantage.
4. Installations, inspections, and removals of test parts may be accurate, thorough, and geared to the facilities and time available.
5. Permanent location and work concentration in one place make for less dependence on mother nature and the weather.
6. Also available are wholesale buying power, use of manufacturing machines and measuring tools, and highly skilled personnel.

Fig. 2—Field testing tells the manufacturer whether parts are too large or awkward to handle under field conditions

Field testing accrues these benefits:

1. The equipment is used realistically and will complete the jobs for which it is made. Under the customer's conditions, we learn; expected life; whether our demands on operators are excessive; if we are asking too much with regard to fuels and lubricants; if the machine is properly balanced with respect to center of gravity, acceleration and deceleration, speed, and various attachments; if operator's likes and dislikes are satisfied; and many uses, not anticipated by manufacturer, to which customer subjects equipment.
2. When equipment leaves plant, much is learned of packing and shipping problems and need for rust-proofing and protection from dirt or damage.
3. As the parts are placed on the customer's machine, we uncover assembly difficulties in field. See Fig. 2.

Although each method has its special merits, remember that the two go hand-in-hand. Achieving the final goal calls for judicious use of both proving ground and field testing.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Save 43¢ per Peening $

GLOWING reports on the saving shown by the new peening shot types—cut wire and cast steel—over chilled iron shot led to production tests at Ford comparing the three types. Test results showed the two new shot types net a 43% saving compared with chilled iron shot.

Fig. 1 shows the three types of shot tested. Fig. 1a shows a typical chilled iron structure with the following chemistry: C 3.17, Mn 0.36, Si 1.57, with a hardness of Rockwell C 59 to 64. Fig. 1b shows a typical structure of cast steel that had been heated above the critical range, quenched, and drawn with the following chemistry: C 1.10, Mn 0.43, with a hardness of Rockwell C 47 to 55.

Fig. 1c shows a typical hard drawn wire structure with the following chemistry: C 0.69, Mn 0.82, with a hardness of Rockwell C 44 to 47.

Flat Springs Tested

It was decided not only to check breakdown of the shot, but maintenance material and labor as well as the fatigue life of springs shot peened with each type of shot. The flat spring department at the Rouge was selected as the ideal department to run such a test.

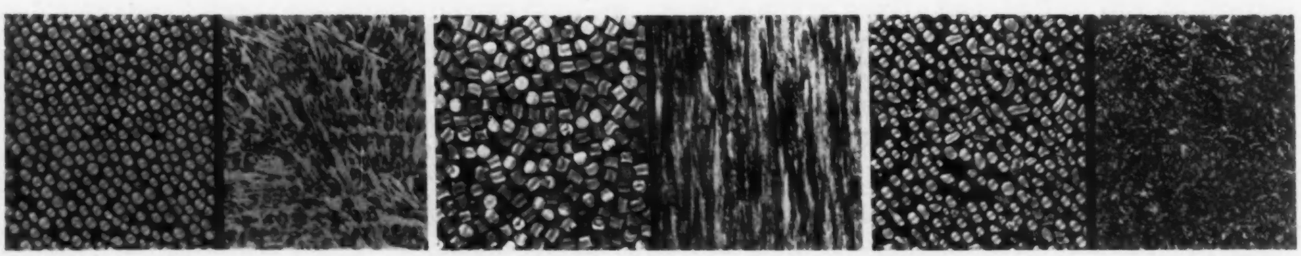
Two straight-away continuous conveyor type of machines, Fig. 2, were used for the tests. The spring leaves were shot peened on the tension side only, under the following conditions:

Wheel Speed	2250 rpm
Wheel Dia.	19½ in.
Blade Width	5 in.
Number of Wheels	1
Conveyor Speed	28 fpm
Arc Height	0.015 ± 0.002 A2

At the start of the test new blades were installed and other worn parts replaced.

The machines were cleaned of all the old shot. No. 1 machine was loaded with new chilled iron shot. No. 2 machine was loaded with cast steel shot and the test was then started on actual production parts. A record was kept of number of production parts, hours of operation, maintenance parts, and breakdown of the shot. A sample of shot was taken from each machine each day and given a screen test to determine the size distribution in the machine. The amount of shot added each day was plotted to check the breakdown.

Since many operating data on chilled iron shot were available, machine No. 1 was operated for only 346 hr to act as a check for previous values. At that time cut wire was added to that machine, on top of the chilled iron already in the system with the thought in mind of giving the cut wire a chance to



A B C

Fig. 1—Peening shot types tested and their structure. Shown in "A" is chilled iron shot; in "B," cut wire shot; and in "C," cast steel shot

With Two New Shot Types

EXCERPTS FROM PAPER* BY

A. E. Proctor

Manufacturing Research Department, Ford Motor Co.

* Paper "Some of the Economical Aspects of the New Types of Shot," was presented at a meeting of the Shot Peening Division, of the SAE Iron & Steel Technical Committee, Hagerstown, Md., June 27, 1950.

condition itself before starting the test. After 48 hr, it was determined by inspection that all of the chilled iron was out of the machine. New blades were installed and the test on cut wire was started in No. 1 machine.

The shot distribution and breakdown are recorded in Fig. 3.

Chilled iron shot, which was an SAE S230, required 96.8 lb per hr to maintain the following distribution:

18% on the #25 screen	0.028-in. opening
22% on the #30 screen	0.0232-in. opening
10% on the #35 screen	0.0197-in. opening
16% on the #40 screen	0.0165-in. opening
31% on the #60 screen	0.0098-in. opening

Cast steel shot, which was an SAE S230, required 7.6 lb per hr to maintain the following distribution:

24% on the #25 screen	0.028-in. opening
43% on the #30 screen	0.0232-in. opening
10% on the #35 screen	0.0197-in. opening
9% on the #40 screen	0.0165-in. opening
13% on the #60 screen	0.0098-in. opening
3% on the #80 screen	0.007-in. opening

Cut wire, which was 0.035 in., required 4.9 lb per hr to maintain 94% on the #25 screen.

After a 1000 hr of operation, it was found that the consumption of cast steel was still 7.6 lb per hr and the cut wire was still 4.9 lb per hr.

Fig. 4 shows blades after 95 hr of operation with chilled iron shot. When using cast steel or cut wire, the life of the blades was increased to about 1900 hr at the time of writing and are still in service. This not only saves the cost of 23 sets of blades, but also saves the maintenance labor of installing them.

There is also a savings in the maintenance labor and material in maintaining the dust collectors on this equipment. However it is of interest to note that the wear on the rest of the machine remains practically constant, irrespective of the type or condition of the shot.

The cost comparison between the three types of shot in Table 1 is charted in Fig. 5. These figures show a savings of 43% when using cast steel or cut wire shot. However they represent only a little over 2000 hr of testing and on more extensive tests may be somewhat modified.

Fig. 2—The three shot types were compared in production peening springs on two straight-away continuous conveyor machines

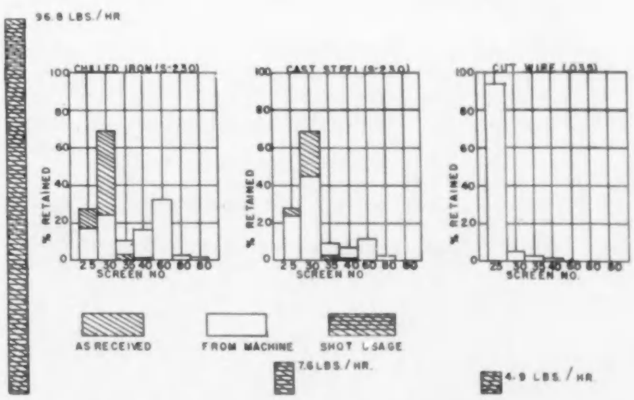


Fig. 3—Screen analysis and shot usage of the chilled iron, cast steel, and cut wire shot compared

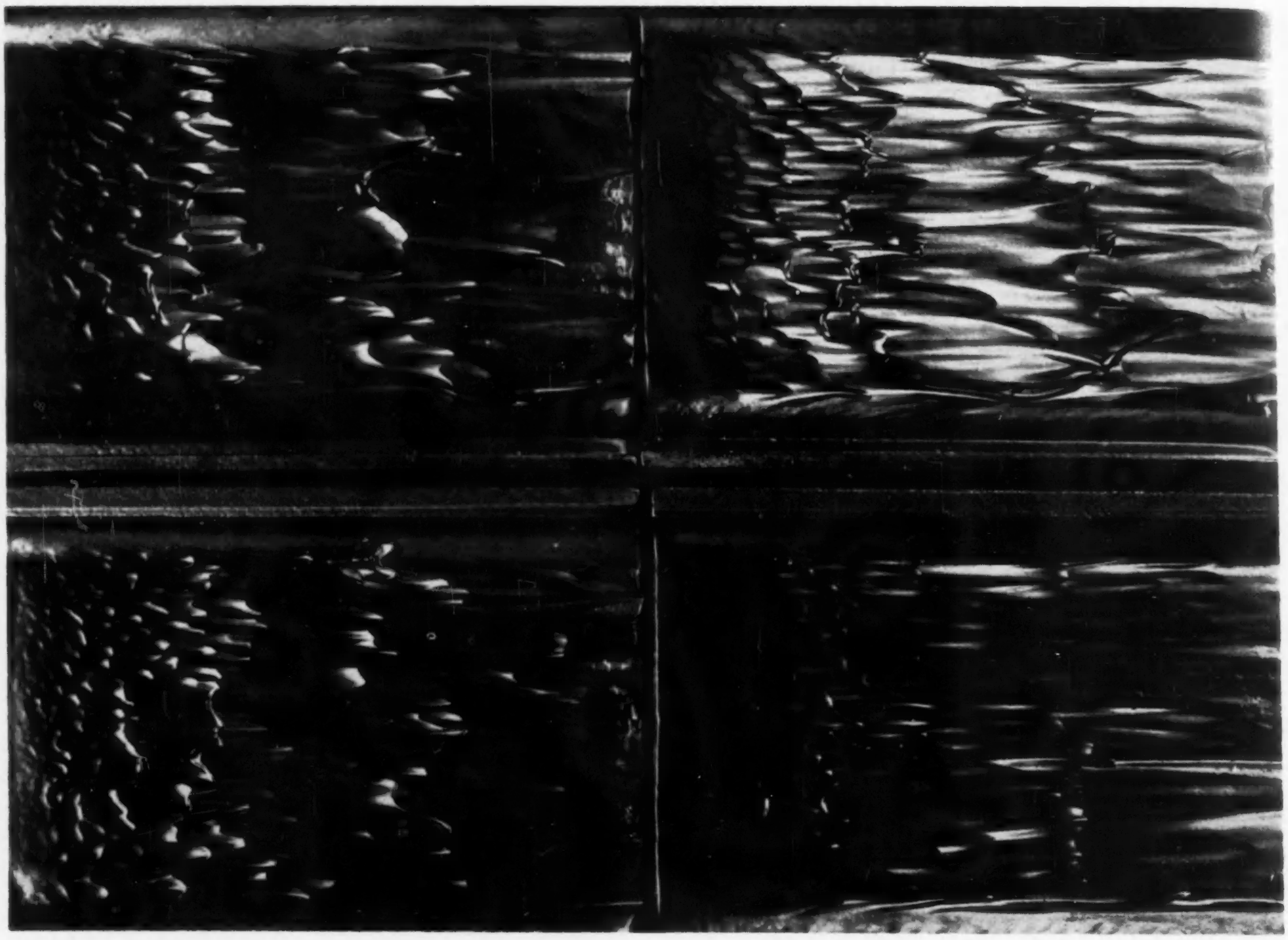


Fig. 4—This is what happened to blades after only 95 hr of operation on chilled iron shot. Blades used with cast steel and cut wire shot are still serviceable after more than 1900 hr operation

While the savings are of considerable interest, they are significant only when related to fatigue life and the savings are meaningless if the new shots do not give the increased fatigue life.

Therefore, fatigue tests were run on the springs. All steel used on test springs was from the same heat of steel. The test conditions were as follows:

1. 6 springs not shot peened.
2. 6 springs shot peened with chilled iron shot.
3. 6 springs shot peened with cast steel shot.
4. 6 springs shot peened with cut wire shot.

Table 1—Costs of Three Shot Types Compared

	Chilled Iron	Cast Shot	Cut Wire
Abrasive	30%	6%	6%
Maintenance Material	21%	10%	10%
Maintenance Labor	15%	7%	7%
Power	4%	4%	4%
Production Labor	30%	30%	30%
	100%	57%	57%

The first four leaves were peened on the tension side only. On the No. 1 group, the test was stopped when the first leaf failed. On group Nos. 2, 3, and 4, the test was not completed till a shot peened leaf failed. The fatigue tests were run as shown in Fig. 6.

The test yielded the following results: unpeened springs—147,500 cycles; chilled iron—448,333 cycles; cast steel—448,833 cycles; and cut wire—363,666 cycles.

Fatigue Life Doubled

We do not present this as a conclusive test. But it seems to indicate a trend showing that we can shot peen with cast steel or cut wire shot a savings of 43% of the cost of peening with chilled iron shot, and can expect at least a 2 to 1 improvement in fatigue life over the nonpeened springs. With regard to the difference in average fatigue life, no particular significance should be attached to it in view of the limited number of tests. On a larger scale test, the influence of individual high or low values would be minimized and the average values should fall within the limits of experimental error.

We have also checked the cost of using chilled

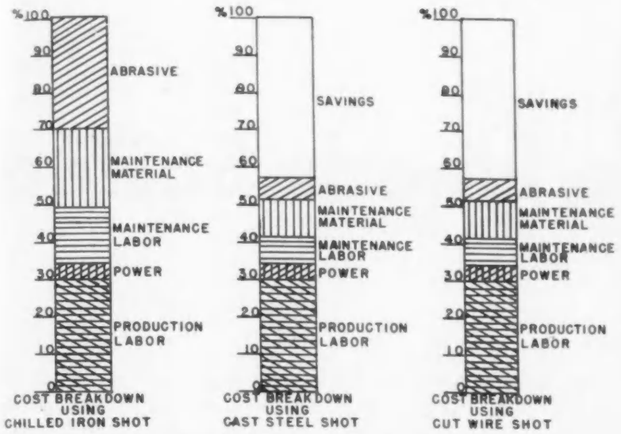


Fig. 5—Cost comparison on the leaf spring job for the three shot types. The two new shot types are 43% more economical to use than the chilled iron shot

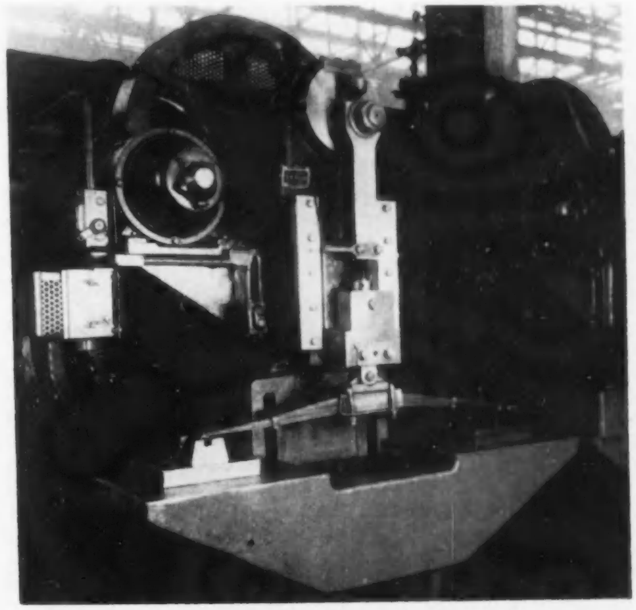


Fig. 6—Leaf springs were tested in this machine to find the increase in fatigue life imparted by each type shot. This test subjected each spring to a 6-in. stroke and a load of 1335 to 1345 lb

iron shot versus cut wire shot on the chassis coil spring at the Ford Motor Co.'s Hamilton Plant. They also report a substantial savings in the cost of shot used in the number of blades used and in maintenance labor to install blades. Now here again, it has been reported that there is just as much maintenance on the rest of the machine when using cut wire shot as when they used chilled iron shot. Consequently the savings will be the reduction in cost of shot used, the number of blades used, and in maintenance labor to replace blades.

From cost figures supplied by Hamilton, their findings in precentage, shown in Fig. 7, are as follows:

a. If the cost of chilled iron shot is 100%, the cost of cut wire is 470%.

b. Considering the pounds of shot used per spring, if chilled iron is 100%, cut wire is 5%.

c. On the cost of shot used per spring, if chilled iron is 100%, cut wire is 24%.

d. The ratio for blade life is chilled iron 100%, cut wire 2370% plus.

e. The ratio for the cost of blades per 80 hr of operation is chilled iron 100%, cut wire 4%.

f. The ratio for the relative maintenance cost per 80 hr of operation is chilled iron 100%, cut wire 4%.

Using these same figures, and comparing them with breakdown of the overall cost of the operation, as in Fig. 8, we find:

- Shot 7%
- Maintenance Material 10%
- Maintenance Labor 7%
- Power 4%
- Production Labor 30%

There is a 42% saving in shot peening chassis coil springs with cut wire shot in the place of chilled iron shot.

On the basis of these tests on production parts it would appear that either cast steel or cut wire shot is a superior material for shot peening. Which one to choose is largely a matter of economics and this in turn will be determined by technological improvements in methods of processing.

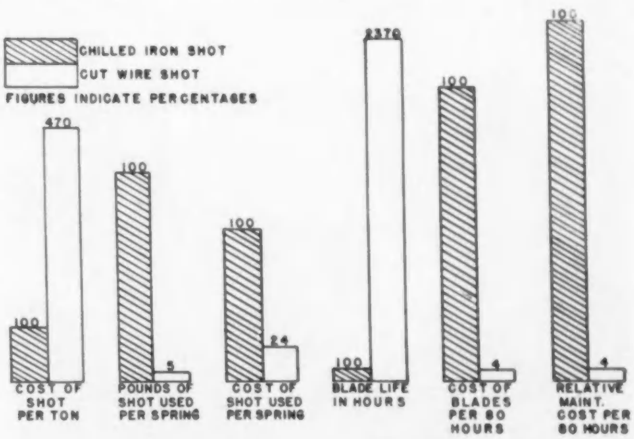


Fig. 7—Comparison of chilled iron versus cut wire shot for peening coil spring at Ford's Hamilton plant

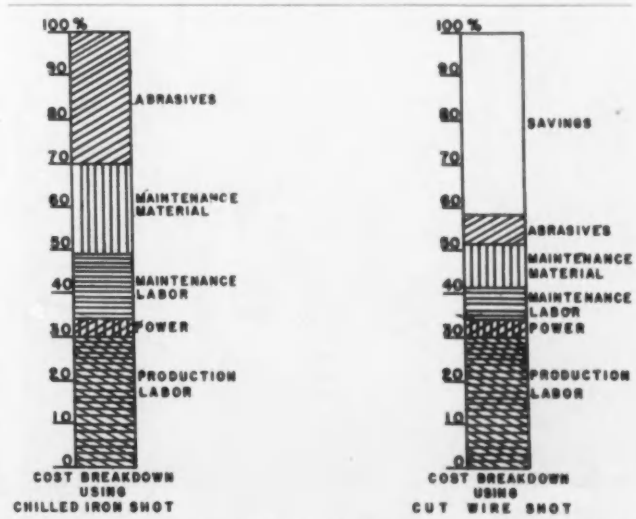


Fig. 8—As in the comparison on leaf spring peening, the saving with cut wire over chilled iron shot for coil springs amounts to about 43%

Unfilled Vehicle Needs Sorted

THE 1950 SAE National Transportation Meeting brought practical help to truck and bus designers from deserts in Arabia, from frozen lakes in Wisconsin, from the military experiences of two world wars . . . and from the highways of America. Men who know from experience what it takes for successful operation in every area came to the meeting ready to share hundreds of man-years of on-the-job research with each other and with designers.

General Chairman of the Meeting T. L. Preble promised attendants high "take-home" pay in his brief welcome opening the first session. At the end, all agreed the program sparked by T&M Meetings Chairman H. O. Mathews and T&B Meetings Chairman F. E. Lautzenhiser had more than fulfilled the general chairman's promise. Total attendance of more than 300 and a sell-out dinner marked the most successful Transportation Meeting in recent years.

General Chairman of the meeting was T. L. Preble (left), chatting with SAE T&M Vice-President M. E. Nuttila and SAE T&B Vice-President W. P. Michell

The sessions were replete with challenges . . . challenges to designers, to operators, and to every branch of automotive engineering. And in each case, the challenge was welcomed, argued, and carried home from the meeting for further individual thought. Trucks were challenged as being too noisy and carrying too many vital parts in hard-to-get-at places. Operators were challenged to keep maintenance standards high and overloads down to prevent accidents and preserve highways. Designers were challenged to learn and profit from operating experiences to better adapt to user purposes both specialized off-road vehicles and those devoted to everyday fleet work.

Ideas offered to meet these varied challenges were manifold . . . and frequently diammetrically opposed. Brisk arguments arose on nearly every question posed—and most of the debates were still going on when the sessions ended. Healthy differences of opinion were more common than final agreements. But always a wealth of specific data was exchanged to everyone's benefit.

"Use bigger and better mufflers," for example, was one of the direct suggestions made to meet the challenge that trucks are too noisy. Cost of mufflers with larger cubic capacity and long-life materials would not be excessive, users urged, and would help considerably because exhaust sounds have a wide range of audible frequencies. Better mufflers can be made, most agreed. But trying to pin down the reasons for their absence from most trucks unveiled a shift-the-blame attitude among the three groups concerned. Muffler makers say that truck buyers won't buy such mufflers nor allow room for their installation. . . . Truck manufacturers claim operators aren't willing to pay for them. . . . And fleet men argue that their requests for better mufflers go unanswered.

But there's more to it than just mufflers, others urged, pointing to the complexity of the noise-hearing part of the problem alone. Ways to measure the physical factors involved in traffic noise were detailed from SAE Vehicle Noise Committee reports; but even the instrumentation developed by these lengthy studies, it was shown, has to be used with

at Transportation Meeting

More than 300 members and guests attended seven technical sessions and the dinner which comprised the meeting, developed under the leadership of T. L. Preble, Tide Water Associated Oil Co., as general chairman.

Serving with Preble on the General Committee for the meeting were: M. E. Nuttila, SAE vice-president for Transportation & Maintenance; W. P. Michell, SAE vice-president for Truck & Bus; H. O. Mathews, T & M Meetings Committee chairman; F. B. Lautzenhiser, T & B Meetings Committee chairman; Metropolitan Section Chairman E. N. Hatch, and Leslie Peat.

groups of people acting as "juries" to check the readings of their own ears. The pitch and intensity of sound which bothers some, doesn't bother others at all!

The bus and the truck took equal shares of a challenge to provide better accessibility. Specific suggestions were given to designers—and welcomed by their spokesmen. A bus operator, for instance, listed the following inaccessibilities after studying vehicles of almost every make operating from coast to coast:

> Spark plugs were inaccessible on two leading makes of postwar buses;
>
> On one model, distributor points can be seen only with a mirror. . . . On another, distributor timing must be set through a hole from the inside of the bus, while the flywheel markings used for timing can be seen only from a pit under the bus;
>
> Valve rocker arms must be removed on another truck to tighten cylinder-head bolts. . . . On another, manfolds have to be removed to tighten these bolts;
>
> The fan accessory shaft on some models has to be removed to tighten generator and compressor belts;
>
> On one make, removal of 23 body panel bolts is the first step in inspecting the door mechanism;
>
> Many makes so hide the windshield wiper that the necessary frequent inspection becomes almost a major body job;
>
> Fuse panels are often inaccessible; electric wiring is too complex; lubrication fittings often are inaccessible.

Suggestions for improving accessibility on trucks were also made. Among them were:

> Cabs on COE (cab-over-engine) trucks should be designed to permit tilting away from the engine or floorboards—and so that engine and engine cover can easily be removed;
>
> Generators, fuel pumps, carburetors and electrical connections on both COE and conventional trucks should be so located as to be readily removable;

Activity Meetings Chairmen

H. O. Mathews, T&M Activity Meetings Committee chairman, with Fred B. Lautzenhiser, T&B Activity Meetings Committee chairman

Around the Meeting . . . .

SAE PAST VICE-PRESIDENTS representing Transportation & Maintenance and Truck & Bus appeared in large numbers at this meeting, particularly at the Accessibility Symposium. Among the T&M past vice-presidents spotted were Ted Preble, Harry Mathews, Matt Nuttila, Jean Ray, Emil Gohn, "Bing" Hatch, and Don Wilson . . . and among the T&B past vice-presidents, B. F. Jones, Horner, Fred Lautzenhiser, Merrill Horine, B. B. Bachman, Ray Buckendale, Stephen Johnson. . . . Others at the meeting who have served as SAE vice-presidents for other activities included SAE President J. C. Zeder and the 1951 nominee for SAE President, J. E. Hale.

* * * *

JAMES K. KNUDSON, recently-appointed administrator of the Defense Transport Administration, sent the following telegram:

"Regret inability to attend your National Transportation Meeting due to press of business in Washington and elsewhere. Am familiar with the outstanding contribution made to motor vehicle maintenance by your Society and its component units during the past war. Functioning through the SAE-ODT Maintenance Coordinating Committee and its 30 project committees. Work of these experienced automotive engineers was of great value in keeping America's highway transport equipment rolling during War and in providing scientific reference material for maintenance of automotive equipment following war. Sincerely trust that defense production program will not entail crippling shortages of repair parts, tires, motor fuel, or other vital supplies. If such critical problems arise will have no hesitance in calling upon your group, through appropriate channels, to assist with advice and information with respect hereto. Best wishes for successful meeting."

* * * *

Meeting in convention on the floor below the SAE Transportation Meeting in the Hotel Statler on October 17 were the men who run the pari-mutuel windows at New York race tracks . . . which increased circulation of the wheeze-of-the-week about business being very bad in Brooklyn because of the current gambling investigations, despite its being good elsewhere in the country. "It's so bad in Brooklyn now," the rumor says, "that one bookmaker had to lay off three cops last week."

Brakes, steering gears, valves, clutches, and other fast-wearing parts requiring adjustment should be more carefully positioned for accessibility by designers.

"I recognize that engineering is a compromise," one fleet operator said, "but I suggest the designer compromise with the operators as much as with his own sales department."

The accessibility discussions brought out, in addition to the suggestions listed, many general benefits of greater accessibility. Greater accessibility, it was noted, will:

Help the operator's miles-per-man-hour, which are just as important as his miles-per-gallon;

Extend parts life by encouraging instead of discouraging frequent adjustments and preventive maintenance operations.

Reduce the downtime of vehicles in shops; enable them to be earning money more of the time.

One fleet operator laid at least part of the blame for inaccessibility on himself and his fellow operators. "Few of us," he charged, "pay enough attention to accessibility in deciding what truck or model we are going to buy."

Need for good maintenance if accident rates are to be kept down was stressed at one session where common carrier accident records were the basis of the challenge.

First it was shown that mechanical-defect accidents in most years follow the same upward or downward trend as do all accidents reported by motor carriers to the Interstate Commerce Commission. But, in the war year of 1943—when shortages made adequate maintenance impossible—the number of mechanical-defect accidents went up considerably while all accidents decreased. For the three high war years, in fact, mechanical-defect accidents averaged 10% of all accidents recorded in these motor carrier figures—as against 6% for the last two years.

That means, according to engineers at the meeting, that the current rate—which results from normal maintenance—as compared with the wartime rate reflects a decrease of approximately 900 accidents, 40 lives, 500 injuries, and about $1,500,000.

During this maintenance-accident discussion, brakes, as always, got special attention. Bad brake adjustments on tractor-semitrailer combinations from 1945 to 1949, it was stated, accounted for nearly 25% of the total service brake accidents recorded in these ICC reports. Other causes of brake accidents, it was said, included: breaking of tube and hose, nearly 14%; brake valve failures, 10%; leakage, 6.4%; greasy, wet, or loose lining, almost 7%; loose or fouled brake valves, 4.5%; and hydraulic cylinder failures, 3.5%.

Several operators agreed that faulty brake maintenance, particularly adjustments, were responsible for brake failures. But they urged vehicle builders to give them better-designed equipment to work with. Fleet men want to make quick visual inspection of lining thickness and shoe clearance without pulling wheels and brake drums. Improved automatic brake adjusters, feel, will help overcome this design deficiency.

"There is a 9-to-1 chance of improving truck accident records by proper maintenance," one engineer opined in summarizing his views of the data and discussions.

Operators rather than designers were targets for the challenge made at the meeting to vehicles of more than 18,000 lb axle loading. "The nation's highways need the protection of the 18,000 lb axle load limit—and the 5% of all trucks and combinations which are exceeding it should be made to pay higher road costs they entail." That was the gist of a Bureau of Public Roads representative's contention to the assembled operators and designers. Current road tests being made in Maryland, he claimed, will supply further evidence to back up his statements.

This point of view brought rebuttal from a variety of operators, some of whom opposed the Bureau of Roads viewpoint violently, others of whom disagreed in milder terms. No concensus of opinion resulted from the exchanges.

Positive, helpful data for designers accompanied the challenge to better adapt vehicles to off-the-road use in general and to desert conditions in particular. Involving problems common to both military and civilian design, this exchange of ideas brought comments from both commercial and military designers and both civilian and military users.

From 17 years of desert operating experience, one civilian user, for instance, listed seven requirements for off-road mobility which he considers essential:

1. Off-road tires must be operated at low inflation pressure on all vehicles;
2. All-wheel drive is needed, except on light cars;
3. All vehicles need more-than-average engine power;
4. All vehicles need low-speed axle gear ratios;
5. Main and auxiliary transmissions on all trucks should have low ranges and top direct;
6. Larger trucks must have power steering;
7. On larger trucks, compressed air should be available for tire inflation.

Commercial designers agreed that these and other special requirements might well be used as standards for trucks designed for operation in many overseas areas. "We have seen any number of large fleet operators overseas," one such designer commented, "where the field has requested certain specifications such as double-channel frames, auxiliary transmissions, specific wheelbases, etc. Then someone sitting here in the United States, without too great a knowledge of the operation, deletes or changes the requirements. Result: eventual costs to the local operating company are 10 times the initial saving."

Importance of proper tire application was greatly stressed by almost every discusser of the off-road problem. Application of techniques developed from the previously mentioned 17 years' experience, one engineer said, had enabled him on one overseas operation to increase tire life from 5000 miles on 13.00×24 tires to more than 20,000 in many cases. Army engineers agreed with the tire requirements under discussion, but pointed out that the Army has to compromise some, because it has to try to meet all the requirements in one tire. So, they said, the Army uses stronger cords with fewer plies than in normal commercial use, but with additional cap

. . . . Around the Meeting

SPEAKERS TABLE GUESTS included many prominent figures in the transportation industry in addition to SAE officers and past-presidents. The list:

F. B. Lautzenhiser, T&B meetings chairman; John A. C. Warner, SAE secretary and general manager; C. J. Livingstone, assistant to executive vice-president, Gulf Research & Development Co.; SAE Past-President L. Ray Buckendale; SAE Treasurer and Past President B. B. Bachman; W. P. Michell, T&B vice-president; General Chairman T. L. Preble; Capt. D. L. Madeira, representing Commandant, Third Naval District, New York; E. D. Bransome, president, Mack Mfg. Corp.; Dinner Speaker Gen. Brehon B. Somervell; Toastmaster J. N. Bauman; SAE President James C. Zeder; Edward F. Coogan, president, Autocar Co.; M. E. Nuttila, T&M vice-president; B. I. Graves, vice-president, Tide Water Associated Oil Co.; Frederick R. Kappel, vice-president, American Telephone & Telegraph Co.; Harold P. Hobart, vice-president, product development and product engineering, Gulf Research & Development Co.; H. O. Mathews, T&M meetings chairman; and Robert Gardner, Metropolitan Section T&M vice-chairman.

* * * *

MOST IMPORTANT off-the-speakers-table guest at the dinner was SAE's First Lady for 1950, Mrs. James C. Zeder. With her was James, Jr., just started as a trainee at McCann-Erickson advertising agency.

* * * *

BEST LAUGH OF THE MEETING: Chief dinner-speaker General Somervell's story about the two men in a bar, who noticed a solitary drinker at a corner table who interspersed periods of quiet with audible chuckles and loud guffaws. . . . Then every so often, he would emit a raucous Bronx cheer. Overcome by curiosity, they approached the stranger asking: "How come you break into these chuckles and laughs every so often, when nothing seems to have happened to cause them?"

"Oh, that's nothing," the solitary one replied, "I'm just sitting here telling myself stories. And when I finish one, I naturally laugh at it."

"I see," the curious ones said, "but in that case what's the occasional raspberry for?"

"Oh, that," came the reply, . . . "that's when I tell an old one I've heard before."

At the Dinner

E. N. Hatch, chairman of SAE Metropolitan Section; Gen. Brehon B. Somervell, Koppers Co., Inc.; J. N. Bauman, toastmaster; and SAE President James C. Zeder

A six-point program for bettering military vehicle design was mapped by Gen. Brehon B. Somervell, president, Koppers Co., Inc., who was chief speaker at the Transportation Dinner. Following a welcome to dinner guests by E. N. Hatch, SAE Metropolitan Section chairman, J. N. Bauman, White Motor Co., took over his function as toastmaster. SAE President James C. Zeder spoke briefly, bringing strongly into focus SAE's renewed activity in service to the military. (See page 17, SAE Journal, November, 1950.)

General Somervell challenged automotive engineers to satisfy these six demands in miltary vehicles:

1. Greater fuel and oil economy;
2. Adaptability to mass production;
3. Dependability at extreme temperatures;
4. Lower vehicle weight per horsepower;
5. More accessibility;
6. Parts standardization.

More petroleum products were shipped than anything else during World War II, the General said. Engines more efficient in fuel and oil consumption would help lighten the transport load during war, make room for shipment of other critical items.

If and when World War III comes, we'll need lots of military machines quickly. "The Army is asking industry to engineer these greatly complicated vehicles for mass production," said General Somervell, in calling for the same kind of ingenuity that developed quantity production techniques for commercial vehicles.

Because they operate vehicles in all parts of the world, the Armed Forces want dependable starting and performance at as low as -60 F, for the Arctic, and up to 160 F, in the tropics. General Somervell also noted that the military are weight-conscious, and look to greater payload-carrying capacity. "What can you do to reduce weight required in the basic vehicle design so we may have the maximum useful capacity left for carrying the payload needed to do our military job?" he asked automotive men at the meeting.

The military also are echoing the cry of commercial fleet operators for greater accessibility. They want design to simplify inspection and maintenance so it can be done with simple tools—a must at the fighting front. Last point called for by General Somervell is standardized parts. While many items have been standardized, each company has its own parts number on the standard part, confusing maintenance and supply people in the field. He also urged still further interchangeability of common parts, if possible.

and breaker plates to give protection against rocks, stones, etc., yet retain most of the resiliency needed for sand operation.

One prominent designer of off-road military vehicles warned against simply trying to use the biggest possible tires. "Vehicle performance can be injured," he stressed, "by use of larger section tires than the optimum size. It is not true that 'if a large section tire is good, a larger one is better'."

Remarks by a military research officer pointed in

the same direction. Little if any improvement in tire mobility has been realized in recent years, he claimed. "Tires for specific vehicles have been arbitrarily selected to provide the largest tire consistent with space limitations. The tread selection was based on the type of terrain for which the vehicle was intended. Considerations of proper tire dimensions, such as width and diameter to provide optimum mobility, were not based on an understanding of fundamental principles. . . . A real need exists for a program of applied research for the solution of the problem."

Commenting on off-road, desert vehicle tire problems in some detail, one tire representative recited his experience by saying:

"In designing tires for sand operation there were three major obstacles to overcome. First, of course, was the deep, dry, flowing sand; second, was the extremely hot desert air and the hotter desert sand; third, was the hard jebel rocks that are strewn over the desert and the apparent inability of the Arab drivers to miss them. The problem dictated an entirely new approach to tire design. Having little previous experience to draw on, we turned to one of Mother Nature's own developments—the camel—which had, for many centuries, been the only reliable means of desert transportation. From a pack camel's weight and his footprint area we calculated the pressure that dry sand would support without too much penetration. This provided a working hypothesis for calculating tire size requirements for any given load.

"To keep the vehicle center of gravity at a minimum height, for obvious reasons, it was essential that the tire overall diameter be kept relatively low. Because of the high temperatures, the tread must be kept relatively thin and the cross-sectional profile had to be nearly round. To bring as much tread surface as possible to bear on the surface of the sand it was necessary to provide a very flexible carcass for greater deflection. Since number and thickness of carcass plies affect flexibility and, therefore, sand flotation, it is necessary to use a minimum number of plies of as strong a cord as obtainable yet otherwise serviceable."

Specific ways to get improvement again dominated in a challenge to fleet owners to get optimum results from fuels and lubricants now available. Any one gasoline, it was admitted, can be about right for only 25 vehicles out of every 100, but many practical suggestions were made about getting the best results for any individual vehicle.

Among these suggestions came this one from petroleum technicians: "Experience will show which vehicles in the fleet are sensitive to gasoline quality. Perhaps 10-15% are the trouble-makers. Concentrate on these units at first. Many corrective measures will increase performance and better economy, in addition to suppressing knock. A few engines will probably need spark timing retarded from the standard and temperatures set cooler than the general run of the fleet, perhaps even to the point of a slight performance loss. It is better, however, to take a little performance penalty with these few vehicles than to saddle the whole fleet with a higher cost fuel than is necessary. Do not set back all engines in a fleet to the same compromise settings necessary for the few critical units."

A fleet man warned his confreres against increasing an engine's compression ratio so that low antiknock requirement engines can squeeze a performance gain from regular grade gasoline. Consult your engine manufacturer before shaving down the head, he urged, because bearings, pistons, and other parts aren't built to withstand higher power outputs.

The current oil situation too was shown to challenge fleet man and engine designer alike. Reports from the field had it that varnish and sludge still plague engines, even those using high-additive, high-detergent oils.

It's high time that additives were put into the engine, rather than in the oil, argued a petroleum man. For example, he said, in one test a production engine in the field showed high deposits on high detergent oils because of under ventilation of crankcase and over-cooled jacket. Installing a high-temperature thermostat and a blower for positive crankcase ventilation plus other small changes greatly reduced deposits, even though only a regular oil was used.

It became clear before the end of the meeting's discussion that the petroleum industry is trying to produce both fuels and lubricants that at all times meet fleet vehicle requirements—and that better products are constantly being developed. It seemed also agreed that there is still room for design and metallurgical improvements in automotive equipment that will not only improve performance and economy, but also will make the equipment less critical in some of its fuel and lubrication needs.

Researchers reporting on off-road testing on a frozen lake concluded that four-wheel drive vehicles with the torque load distribution properly equalized provide maximum traction as compared with front-wheel drive and rear-wheel drive vehicles.

Under the general chairmanship of **T. L. Preble,** the following served as chairmen of seven technical sessions of the SAE National Transportation Meeting: **H. O. Mathews, F. B. Lautzenhiser, E. J. Gay, W. P. Michell, M. E. Nuttila, F. K. Glynn,** and **M. C. Horine.**

This report is based on discussions and nine papers . . . "Why 18,000 Lbs.? Axle Load Effect on Highway Design and Operation," by **H. S. Fairbank,** U. S. Bureau of Public Roads; Symposium on Automotive Traffic Noise: "Report of Automotive Traffic Noise Subcommittee," by **Paul Huber,** Fram Corp.; "Why Not Quiet Those Trucks," by **E. J. Abbott,** Physicists Research Co.; . . . . "Automotive Transportation in Saudi Arabia," by **R. C. Kerr,** Arabian-American Oil Co.; "Traction and Stability of Front, Rear, and Four-Wheel Drive Trucks," by **A. H. Easton,** University of Wisconsin; Accessibility for Maintenance: "Trucks," by **H. O. Mathews,** Standard Brands, Inc.; "Buses," by **Randolph Whitfield,** Georgia Power Co.; . . . . "What the Fleet Operator Should Know About Fuels and Lubricants," by **G. A. Round** and **W. S. Mount,** Socony-Vacuum Oil Co., Inc.; and "Relationship Between Maintenance and Motor Carrier Accidents," by **H. H. Allen,** and **Louis Reznek,** Section of Safety, Bureau of Motor Carriers.

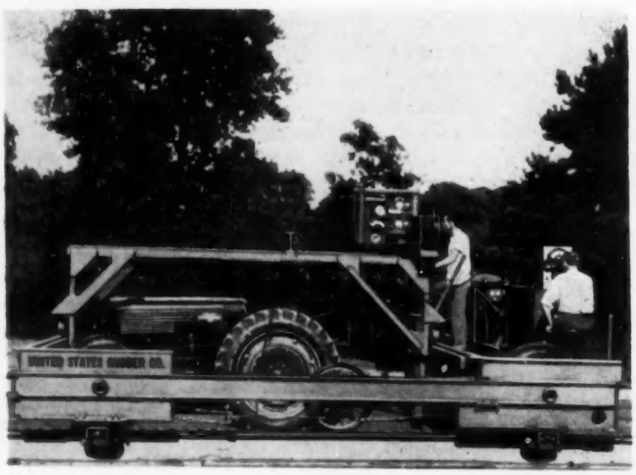
All of these papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be printed in full in SAE Quarterly Transactions.

WIDE-BASE RIMS . . .

How They Affect Farm

Difference in performance of tires on narrow and wide rims in sand, loam, and clay is practically negligible for farming and field work. This was shown by tests conducted jointly by U. S. Rubber Co. and the U. S. Department of Agriculture at the latter's Tillage Machinery Laboratory, at Auburn, Ala.

Test Method

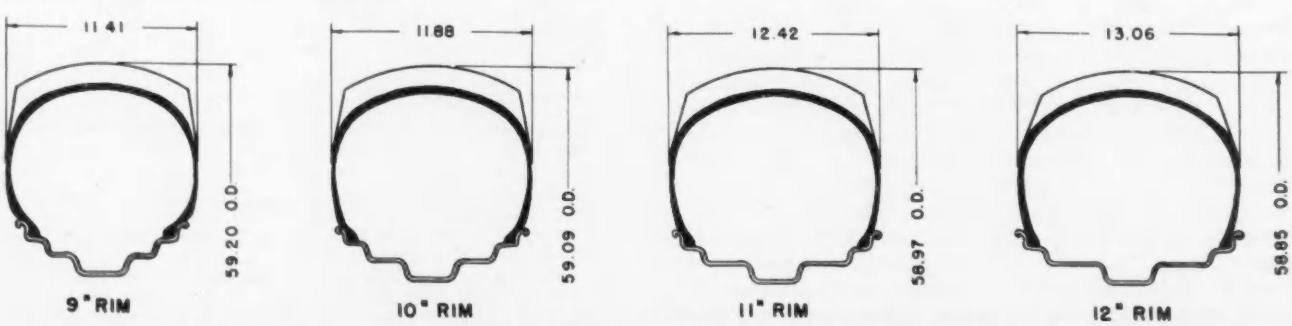


The special test machine, at left, was used for these tests. Power unit of the machine is a farm tractor mounted on a movable frame. Front end of tractor is supported on rollers. Machine has only one driving tire. Dynamometers on machine measure drawbar pull and torque or force applied through axle. Other electrical instruments measure tire revolutions, travel distance, and time. A 16-mm electric movie camera automatically records instrument readings.

Soil types tested were Norfolk sand, Davidson loam, and Decatur clay. Soils were prepared by subsoiling, discing, blading, packing, and rolling.

Each tire and rim combination was tested under eight different drawbar pulls. Results were computed from test data, to show relative performance of tires on rims of different widths at heavy working loads.

Tires and Rims Tested



Scale drawings above show dimensions of the tires and rims tested. Four U. S. Royal 11-38 four-ply tires were used on 9, 10, 11, and 12-in. rims. The tires were air inflated to 12 psi and operated at a static load of 2000 lb. Adjustments were made in applied load to correct for variations in rim weights.

Tractor Tires

Lug Height Tests

Also evaluated in this test program was the effect of lug height on performance of rear farm tractor tires. Results showed: (1) in loose sand, tires with low lugs (1/2 in.) outperformed those with high lugs (1 3/4 in.); (2) in loam, the low lugs were a little better than the high lugs; and (3) in clay, there was little difference between low and high lugs.

EXCERPTS FROM PAPER* BY

I. F. Reed,

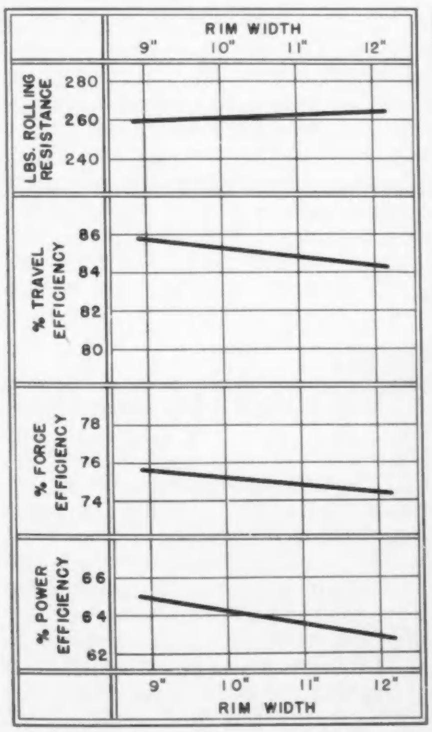
Senior Agricultural Engineer, Division of Farm Machinery, U. S. Department of Agriculture, U. S. Tillage Machinery Laboratory

J. W. Shields,

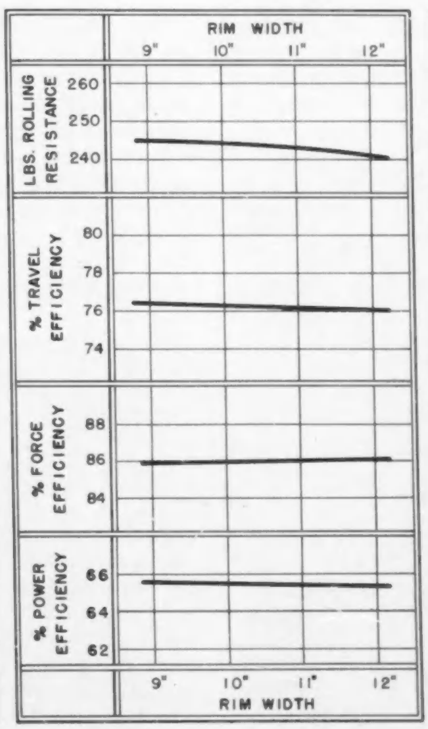
Manager, Farm Tire Division, Development Department, U. S. Rubber Co.

* Paper "The Effect of Lug Height and of Rim Width on the Performance of Farm Tractor Tires," was presented at SAE National Tractor Meeting, Milwaukee, Sept. 13, 1950. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.

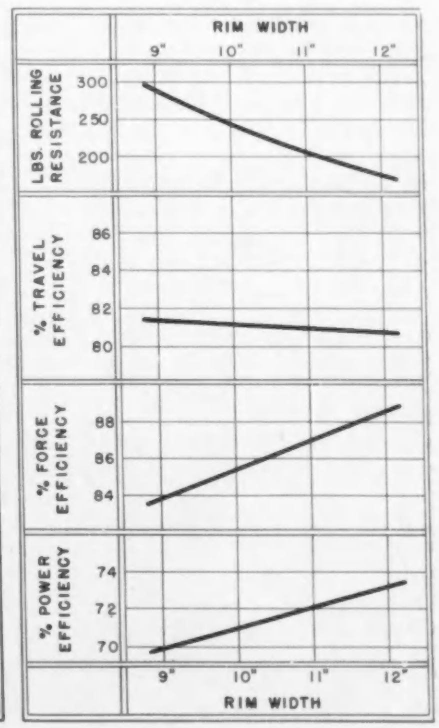
Test Results



In Sand, the tires with narrow rims perform better than those with wide rims. Comparisons are at 800-lb drawbar pull.



In Loam, width of the rim has practically no effect on tire performance. Comparisons were made at 1300-lb drawbar pull.



In Clay, tires with wide rims give best overall performance, with little lower travel efficiency. Drawbar pull was 1400 lb.

Waste Heat Disposal-Major

MAJOR problem in the design of high-output aircraft engines is the disposal of waste heat, for only about 30% of the energy in the fuel is converted into useful work, leaving 70% that is released as heat.

The disposal of this heat is critical only in the exhaust quarter of the cylinder head—the exhaust valves, valve seats, valve guides, and other parts close to the exhaust port. In fact, tests of an aircraft-engine cylinder have shown that 42% of the heat rejected by the fins flows through those in the exhaust quadrant. (See Fig. 1.) This fact is also borne out by Fig. 2, which shows typical temperatures measured in the cylinder head.

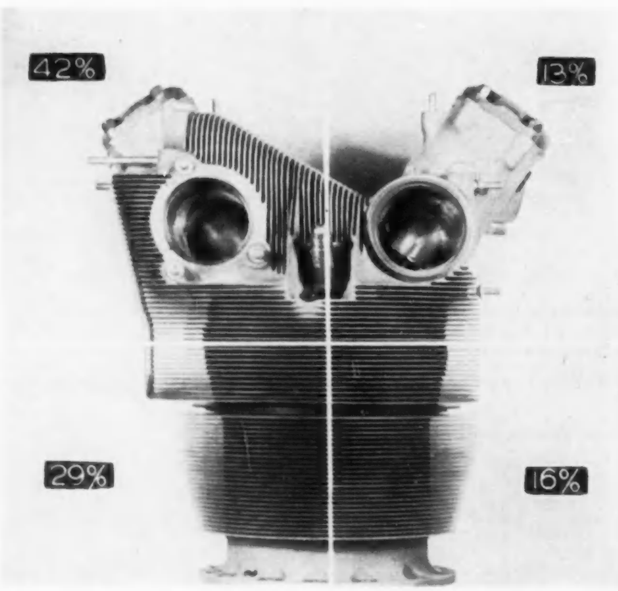


Fig. 1—Division of heat to cooling air. Vertical division is on centerline of cylinder and horizontal separator is at highest level reached by top of piston. Division of heat between four cooling air streams is same for both high- and low-output conditions (heat remaining in exhaust gas after it has passed out of port is not included in above figures)

Some of the effects of excessive heat are evident in Fig. 3, which shows a heavy coke formation on the valve spring and in the rocker box. The deposits on the valve stem tend to cause sticking. Accumulation of coke on the spring still further increases its temperature and causes sagging or loss of tension.

It is for this reason that much of the experimental work done in connection with the development of the R-4360—the 28-cyl, 3500-hp Wasp Major engine—was devoted to finding out what temperatures were reached at various points in the exhaust area and in devising ways of reducing the critical ones.

Discussed here are the heat problems involved in designing the following parts of the exhaust region:

1. Valve head and stem.
2. Port.
3. Valve-seat ring.
4. Valve guide.

Exhaust Valve

The head or dome of the exhaust valve is exposed to the flame inside the cylinder, which is at a temperature of 3500-4000 F.

Measuring the temperature of the valve itself is a difficult matter, as it is with any moving part. Inferential methods are easier than direct measurement. One such method is illustrated in Fig. 4. A valve is made of a steel, such as GM-8440, which can be hardened, and will draw to a lower hardness when it is reheated. This valve is then run in the engine for 2 hr, after which, it is taken out and sliced in two, so that the hardness can be measured at numerous points. From these figures, temperatures can be estimated with the help of test results from the same kind of steel, tempered in a laboratory furnace with accurate controls. This method of test, of course, requires a hardenable steel with consistent drawing characteristics, and does not lend itself to use with the stainless steels most suitable

Aero Engine Design Problem

BASED ON PAPER* BY

Earle A. Ryder

Consulting Engineer, Pratt & Whitney Aircraft, Division of UAC

*Paper, "Recent Developments in R-4360 Engine," was presented at the SAE Summer Meeting, French Lick, Ind., June 5, 1950. This paper was published in full in SAE Quarterly Transactions.

for exhaust valves. A study of temperatures obtained in this way shows that an aluminum boss surrounding the upper end of the guide aids cooling.

To check the method and also to determine the difference in temperature, if any, between valves of different materials, the optical method was also used. Under severe conditions, which are the ones to worry about, the head and fillet of the exhaust valve run red hot, so it is only necessary to cut a hole in the cylinder head in such a position that one can view the valve through an optical pyrometer. A hole about 1 in. in diameter is drilled in a position over the fillet of the exhaust valve, and a pipe about 1 ft long is inserted in it. At the upper end of the pipe there is a quartz window. To help keep the window clean before readings are taken, a small stream of air is blown into the pipe, which escapes with the exhaust gases. Fig. 5 shows the setup. The optical pyrometer is quite accurate above 1400 F, where most of the readings were taken. The valve is hottest at about the stoichiometric mixture and cools very fast as the mixture is richened. It is evident after watching the valve through the window that the most severe conditions for the valve are at cruising (lean mixtures) rather than at take-off or climb, when temperatures are much lower.

There is said to be danger of inaccuracy in this method because of the possibility of reading the temperature of deposits on the valve stem instead of the stem itself. Precautions were taken against this, however, and it was gratifying to find that readings by the optical and the hardness methods checked to within about 20 F.

One of the things learned from this test was the effect of valve steel conductivity on valve temperature. The GM-8440 ran almost 100 F cooler than some of the regular valves. Unfortunately, all the refractory steels seem to have low conductivity, so we cannot take advantage of this knowledge at present.

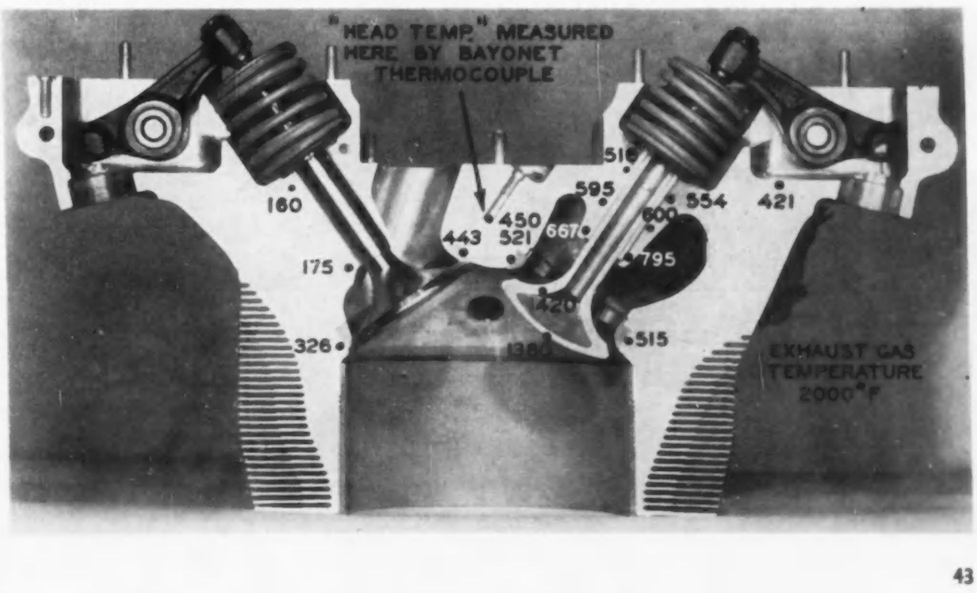


Fig. 2—Section of cylinder head showing some spot temperatures —cruise conditions

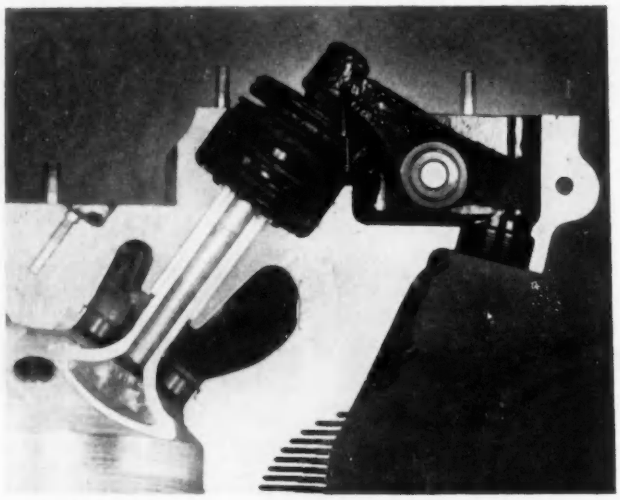


Fig. 3—Section of exhaust ear showing heavy coking of valve spring and rocker box

Increasing the spark advance reduces valve temperature somewhat, but it increases cylinder-head temperature and causes a drastic increase in octane requirements. Valve fillet temperature was not affected when the upper portion of the valve guide (in the rocker box) was cut off.

The circulation of oil around the valve guide through an appropriate passage reduced the valve fillet temperature about 50 F.

Increased back pressure raises valve temperature somewhat, with normal clearance between the stem and the guide. If this clearance is excessively large, however, 14 in. of Hg extra back pressure causes the valve temperature to increase by 100 F.

Reducing the thickness of the valve at the fillet lowers the observed temperature appreciably. This is natural because this portion of the valve is receiving heat from the exhaust gases and is delivering it to the sodium inside the valve. Conductivity of these valve steels is very low (about one-quarter that of mild steel), so there is quite a large temperature gradient across the thickness of the valve, and cutting this thickness in two makes a difference of

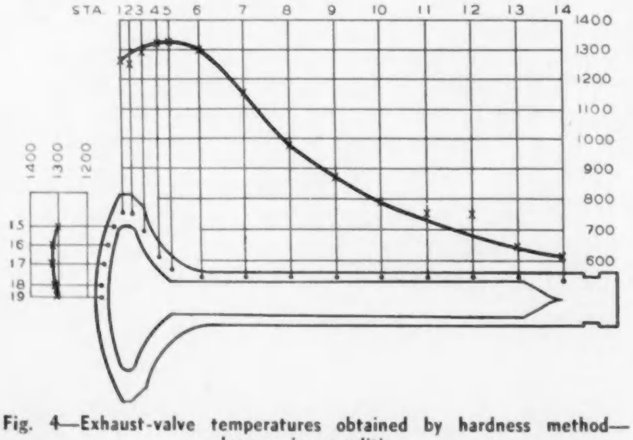


Fig. 4—Exhaust-valve temperatures obtained by hardness method—lean-cruise conditions

70 or 80 F in the fillet surface temperature.

Readings by this method are quite reproducible, checking to within about 10 F for three operators. Despite variations due to engine conditions, one can come back to the same reading on a different test and a different day to within 20–30 F.

Increasing Stem Size

Valve-head temperatures can be lowered by increasing the stem diameter, but at the expense of the stem. A 20% increase in stem size resulted in a 100 F lower head temperature, but the temperature of the stem at the end of the cavity was nearly 100 F higher. The hotter stem leads to aggravated valve sticking because of a higher rate of carbon deposit. This latter effect may be countered by limiting the oil supply to the valve guide by oil seal rings or by a sharp edge on the upper end of the guide.

The temperature of the valve head could be reduced by any means that would interfere with the heat transfer from the gases to the valve. Coatings of stellite or the like are ineffective because they are too thin. Deflectors under the valve head have been suggested, but the big problem is to make something that will stay in the path of the flame and not burn out in less than 1000 hr.

Exhaust Port

It was suggested that if bigger exhaust ports were used, possibly lower gas velocities, and thus less scrubbing of the port walls and less heat pickup by the walls, would result. To test this idea, a cylinder head was equipped with numerous thermocouples in the port and boss region so the temperature pattern could be obtained. This head was then taken off and the exhaust port enlarged by taking out material from inside the port wall. This made the walls thinner but it did not affect the valve guide boss, so it was felt that temperature measurements on the guide itself and the guide boss would represent what might be obtained with a new forging, which would have port walls of standard thickness. This head was then remounted on the engine and the test repeated, but no appreciable difference in temperature was found. This was predicted before the tests on the basis that the gases issue past the valve seat at the speed of sound and do not fill the port anyway. Additional evidence along this line was obtained by running similar tests with an 1830 valve (small size) in a 4360 cylinder head. No measurable differences were found in performance or temperatures.

Since a good part of the heat passes from the exhaust flame directly into the port walls, one scheme—often patented but not generally used—is to line the exhaust passage with a thin stainless-steel shield, which is a loose fit or which touches the walls only occasionally, so that there is an air space between shield and cylinder head. It is quite effective in reducing the valve guide boss temperature, for differences up to 200 F have been measured. It prevents erosion of the aluminum boss by the flame and, if properly made will stand up for extended periods without evidence of cracking or corrosion. In order to help, the shield has to operate at 1600 F. If the shield makes contact with the cylinder head, it runs cooler but does little good. Fig. 6 shows a shielded port.

One unfavorable result of using a shield is to make the valve head run hotter. Normally, the fillet or under side of the valve loses some heat by radiation to the cool port wall. With the shield at 1600 F this source of cooling is cut off or reversed, so the guide and stem are favored at the expense of the head.

Valve-Seat Rings

The seat is not much help in cooling the valve itself, as shown by tests of seat rings having different conductivities. Only a minor effect on valve temperature was obtained with a copper ring having a stainless-steel face. The seat-ring problem is one of keeping the ring tight in the head. It is shrunk in place and sometimes has a thin lip, which is spun into a groove in the cylinder-head port. Heat flow is from ring to head; therefore the ring always runs hotter than the head. A material with low expansion and high elastic limit should be chosen. The ring should be rather skinny, so that it will not have the power to stretch the cylinder head and thus lose its shrink fit.

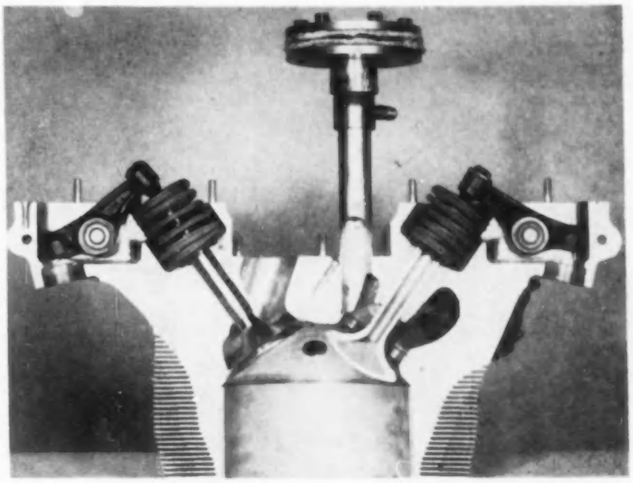


Fig. 5—Tube and window for optical pyrometer used to measure valve temperatures

Valve Guide

The exhaust-valve guide has a hard job to do, and a desirable material for it would have high strength, good hot and cold corrosion resistance, ability to run against a stainless-steel valve stem without lubrication, and good thermal conductivity. We can almost say, "There ain't no such animal." Many materials have been studied and the promising ones made up into actual guides and tested on a single-cylinder engine.

Since the valve guide forms part of the path for the escape of heat from the stem to the cylinder head, it should be of good conductivity or else made very thin. Good performance has been obtained from a composite guide, the upper end of which is of copper alloy and the lower end of Ni-resist iron. Not as satisfactory is a thin Ni-resist guide with a copper backing, so that most of the heat path is through the copper. The end of the guide that sticks up into the rocker box is cooled only by conduction through itself into the midportion of the guide, and then to the cylinder head. Some help is, therefore, gained by adding an aluminum boss, which grows out of the rocker-box floor and surrounds the upper end of the guide.

Valve sticking seems to depend on a combination of guide material, guide and stem temperature, and oil supply. As engine output has increased through the years, temperatures have also gone up, so the point has been reached where there is urgent need for lubricating oil that will stand somewhat higher temperatures than have prevailed heretofore without causing guide corrosion, valve sticking, or preignition.

Fig. 3 indicates how serious the coking problem can be. A heavy crust forms that begins to break off after a while, and the pieces of carbon go through the oil system and lodge in other engine parts. Hard carbon is also liable to form on the valve stem itself and eventually to cause sticking. Rocker-box conditions can be controlled to some extent by changing the oil flow and the method of drainage. There are conflicting needs here, since a high oil flow promotes cooling, but a scanty supply of oil is better from the valve-sticking standpoint.

Definite improvements in engine oil can be expected when the current work of some of the oil companies is completed, but the airline operators must be ready to pay a reasonable price for better oil, just as truck operators do. A third-grade price will not justify the research necessary to develop an oil for severe conditions. They are buying a 10¢ oil now and should not complain if 25¢ is asked for a really improved oil.

(Paper on which this article is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

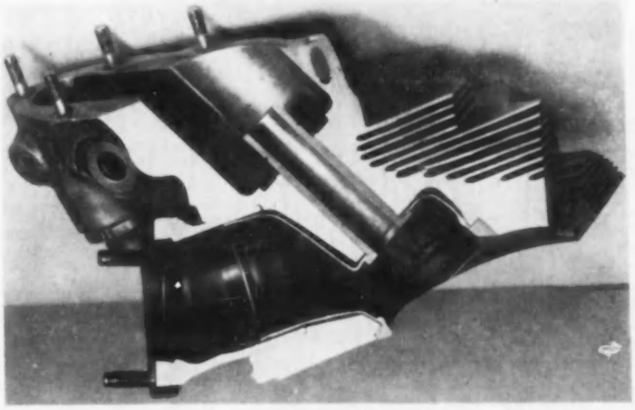


Fig. 6—Shielded port—comparative temperatures are shown below for 2300 rpm, 0.065 F/A ratio, 150 psi bmep, constant cooling airflow

	Standard Cylinder	Shielded Port
Guide Boss, Upper (Average of Two Thermocouples), F	535	405
Boss, Lower (Average of Two Thermocouples), F	728	550
Valve Fillet, F	1420	1485
Cylinder Head (Bayonet), F	450	375

LOW-TEMPERATURE

BASED ON PAPER* BY

R. W. Beal,

Chief, Machinery Group, Engineer and Development Laboratories, The Engineer Center and Fort Belvoir

* Paper "Winterization of Construction Equipment," was presented at SAE National Tractor Meeting, Milwaukee, Sept. 1, 1950.

MAN shares the problems of the machine when he attempts to operate in Arctic climates. Under conditions of intense cold he loses bodily heat rapidly, he starts hard, his movements become sluggish, and his efficiency, as far as any useful work is concerned, is greatly reduced. There comes a point, if temperatures continue to fall, when he resembles a dead engine—and is about as useful.

It has been estimated that man loses 2% in efficiency for every degree below zero. Thus, when the temperature reaches −50 F man has to use all his energy just to keep alive, or he would have to if not provided with some protection and outside assistance. At that low low, the only way you can get any work out of him at all is to wrap him up and cut his heat losses.

Up in Alaska, where the Army has been carrying on research in Arctic operations, they have a word

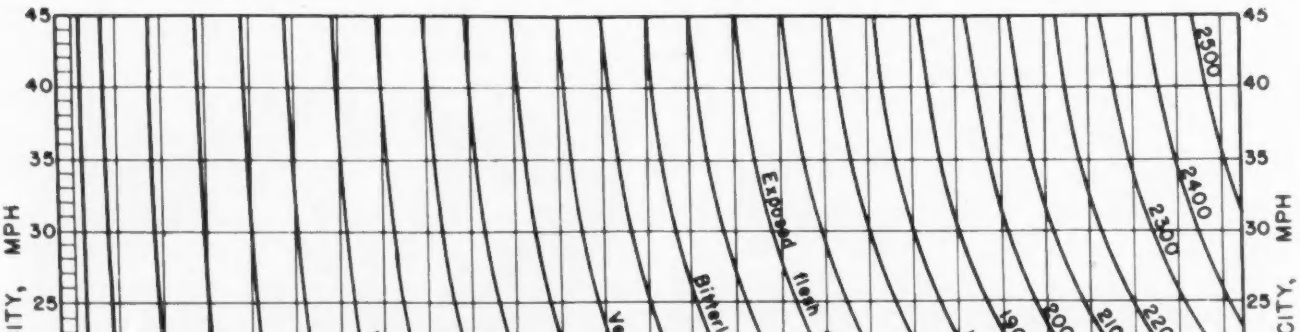


Fig. 1—Cold as sensed by the human body is made up of a combination of temperature and wind velocity. The numerical factor that combines these two is called the "windchill factor," shown by the curves in this nomogram of dry-shade atmosphere cooling

Properties Of Man

Fig. 2—A man clothed for Arctic existence bulks much larger than he does in warm weather clothing

to express this phenomenon of cold as it affects both men and machines. They call it the "windchill factor." This factor is simply the measure of the rate at which a warm body gives up heat under various combinations of temperature and wind velocity. If you look at the chart of Fig. 1 you will find lines representing constant windchill values. Take the line marked "Very cold 1100" for example. It shows that a person gets just as cold when the temperature is 35 F and the wind 45 mph as he does when the temperature drops to −35 F but the wind slows to 1½ mph. When the windchill value reaches 1400 it takes only a few seconds to freeze flesh exposed to the wind.

There have been times at Fort Churchill, Alaska, where the Army carries on, when the windchill value has exceeded 2400. This could mean a temperature of approximately −32 F and a wind of 45 mph, or, at the other end of the scale, a temperature of −40 F and a wind of 25 mph. Whichever way you choose to look at it, it's awful cold—and excellently unsuited for both men and machines.

When men try to play around under windchill values of 1400 to 2400 they have to be dressed in suitable costume and style is no factor. What the well dressed man wears to counter the Arctic weather makes him look more like a National Park bear than a human being (Fig. 2). His normal measurements swell to large proportions. His chest measurement, for example, increases from 37 to 61 in., his ankle from 9 to 28 in. (Table 1). And this has bearing on machines for they are no longer fitted to the man. He cannot work the pedals with his big booted feet; he cannot tighten nuts or bolts with his mittened fist.

The moral of this little story coming out of the frozen North is simply this: Winterizing of equipment for use in the Arctic must take into consideration the Paul Bunyan-like size of the men who have to operate them. Therefore, adequate spacing of handles, nuts, levers and pedals is just as important as figuring how to make the machines themselves efficient.

Table 1—Space Requirements of Arctic Clothing

Parts Measured	Measurements in Inches: With Warm Weather Clothing	With Arctic Weather Clothing
Chest	37	61
Hips	37	64
Ankle	9	28
Head	23	38
Wrist	7½	21
Foot (length)	11	14
Foot (width)	3½	5
Breadth across shoulders	18	32
Thickness thru chest	10	17

Fuel Economy Depends on

STUDY of the effect of engine application on fuel economy shows that:

- Both gasoline and diesel engines have points of operation at which minimum fuel consumption is obtained.
- Variation in the application or variation in the load carried by the diesel truck results in much less loss in fuel economy than in the case of the gasoline-powered truck.
- In applications where larger than normal engines are being used in order to obtain higher *average* operating speeds, the diesel can be expected to give more than the usual economies obtainable with the gasoline engine.

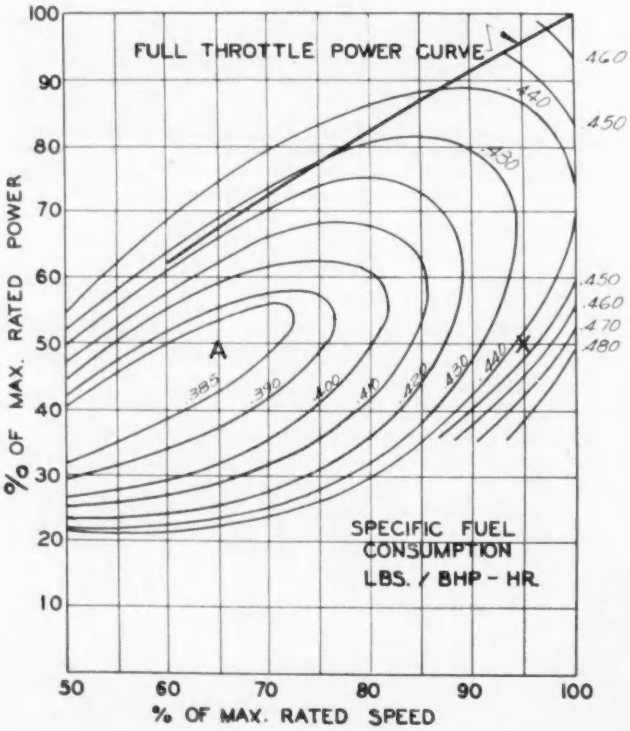


Fig. 1—Typical fuel consumption characteristics of supercharged diesel engine

Basically, the specific fuel consumption is affected by both engine speed and horsepower output. The variation is shown in Fig. 1 for a typical supercharged engine. This kind of chart is obtained from the fish-hook curves usually made during fuel consumption tests on diesel and gasoline engines.

Fig. 1 reveals many interesting fuel consumption characteristics of the engine.

The closing lines resembling contour lines on a map are lines of constant specific fuel consumption.

Maximum fuel economy is obtained by operating the engine at the speeds and horsepowers falling within the "island" indicated by *A*. Specific fuel consumption increases as one departs from this area in any direction.

What does this mean and what practical value does such a chart have? This can best be answered by a few examples.

Assume a trucker is returning empty from a haul. The vehicle weight and load are such that the horsepower and engine speed represented by point *X* in Fig. 1 are required to move the vehicle at the desired speed. The gear that the driver has chosen, however, requires that the engine operate at practically maximum engine speed (as indicated by point *X*). Under this set of conditions fuel is being wasted; since lower specific fuel consumption could be obtained at the required horsepower output by moving the operating point *X* to the left. This shift can be accomplished by shifting to a different gear, which in turn allows the engine to operate at slower speed in order to maintain a given road speed. Of course, the proper gear ratios must be available in the equipment under consideration and the engine should always be operated at a speed in excess of 75% of full rated rpm.

Another use for this chart is to pick conditions under which the engine should be applied in order to get maximum fuel economy. For example, to get maximum economy, the road speed, size of vehicle, and gearing should be such that the engine normally operates as near the region of minimum fuel consumption as possible.

Proper Engine Application

EXCERPTS FROM PAPER* BY

C. R. Boll, Manager—Engine Sales, Cummins Engine Co., Inc.

* Paper, "Fuel Economy Depends on Proper Engine Application," was presented at the SAE National West Coast Meeting, Los Angeles, Aug. 16, 1950.

Similarly, this chart would be of value in picking the most efficient engine speed for applying an engine to industrial applications—particularly those applications with belt, chain, or reduction-gear drives, which allow a flexibility of engine speed; provided, of course, one also adheres to the proper engine horsepower deratings for intermittent or continuous service and altitude.

It would be well to point out here that this discussion deals only with maximum fuel economy and that other factors also affect the application. For example, everyone knows the folly of lugging an engine (that is, operating with full throttle at reduced speed) when, by operating at a higher rotative speed, the throttle setting can be reduced, resulting in a reduction in cylinder pressures that, of course, gives longer engine life. It is not our intention here to say that engine should *always* be operated at the point of minimum fuel consumption, since that may, in some cases, tend to lug the engine; however, we do believe that this matter is one of the factors for consideration in each case.

Charts similar to Fig. 1 can also be made for gasoline engines.

The gasoline engine, however, is notably different from the diesel in that it has a higher specific fuel consumption at the lowest point, and in that the fuel consumption increases much more rapidly as we move away from the point of minimum consumption. The comparison between the fuel consumption characteristics for the gasoline and the diesel engine is shown in Fig. 2.

These curves, which are typical fuel consumption curves for diesel and gasoline engines of approximately 175 hp, illustrate two things:

1. The lower specific fuel consumption of the diesel at the optimum operating point. At three-quarter load and three-quarter maximum speed the fuel consumption of the gasoline engine exceeds the fuel consumption of the diesel by approximately 73%.

2. More rapid increase in the specific fuel consumption of the gasoline engine as we move away from the optimum operating point. For example, at one-quarter load the fuel consumption of the gasoline engine exceeds that of the diesel by over 100%, as compared with the three-quarter load figure of 73%.

Thus, it is clear that the proper application of the gasoline engine to the particular job at hand is much more critical than in the case of the diesel, if maximum fuel economy is to be attained, because not only is the diesel more efficient than the gasoline engine when both are operating at their points of minimum fuel consumption, but the diesel retains its efficiency over a much wider operating range than does the gasoline engine.

In cases where a large engine is used in order to obtain a higher power-to-weight ratio, the higher efficiency of the diesel as compared to the gasoline engine at part-throttle operation becomes quite important. In this type of application the engine is operating at part throttle more of the time and one would, therefore, obtain more than the usual savings by utilizing the diesel engine.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

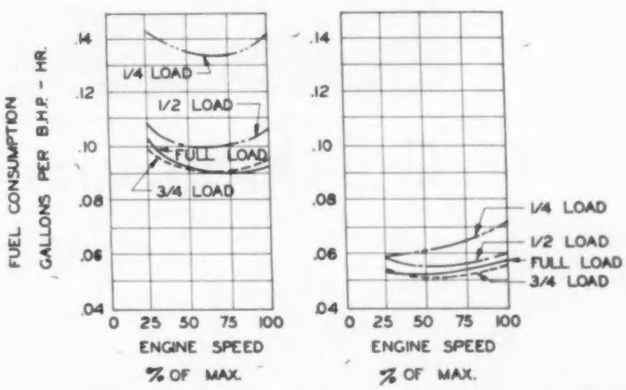


Fig. 2—Typical fuel consumption curves for (left) gasoline and (right) diesel engines

Col. Herbert Watson Alden

1870-1950

COL. HERBERT WATSON ALDEN, who twice served as President of SAE, died at his home in Trenton, Mich. on the eve of Armistice Day, 1950. His 80th birthday would have been Dec. 20.

It is not inappropriate that Colonel Alden's multitude of friends will find themselves in the future honoring his memory and that of the end of World War I simultaneously. He played a major engineering role in that conflict, as the designer of the famous Mark VIII tank—and as an active figure in development of the entire program which brought the first United States and foreign tanks to the battlefields of Europe. He headed an Army Ordnance mission to France and England to study tank warfare, and helped organize the Anglo-American Tank Commission. In 1919, he received the Distinguished Service Medal for valuable service rendered while abroad.

Later, he headed the SAE Ordnance Advisory Committee from its organization in 1920 and during a major part of its life until its work was merged into that of the SAE War Engineering Board in World War II. Throughout this peacetime period, he led in keeping an industry-ordnance team at work. He was a member of the organizing committee which founded the Army Ordnance Association in 1919. He was a consultant to the Chief of Ordnance during World War II. He started his technical career with the American Projectile Co. shortly after graduating from Massachusetts Institute of Technology in 1893.

By training and aptitudes, Colonel Alden was perfectly cut out to fill the unique place in engineering and leadership which was his. As far back as 1894, with two associates, he designed, built, and tested a gasoline-engined tricycle. Then he became assistant engineer of Pope Mfg. Co.'s newly-formed motor car department. With Pope and its allied Electric Vehicle Co. in Hartford he worked for eleven years.

It was about this time that he developed a four-cycle vertical engine, then an innovation, and also the first magnetic transmission for trucks.

After a few years as chief engineer with Timken Roller Bearing Co., starting in 1909, Colonel Alden became chief engineer and part owner of Timken-Detroit Axle Co. Following that move from Canton to Detroit, he continued his association with Timken-Detroit Axle Co. until the time of his death. He served as president of the organization for some years, and later as chairman of the board and as director of engineering.

Colonel Alden was born in Lyndonville, Vt., went to high school in Peoria, Ill. He first served as SAE President in 1912, when, as first vice-president, he was called to fill the unexpired term at the death of H. F. Donaldson. He served again when elected for the year 1923. A founder member of SAE, Colonel Alden participated actively in practically every phase of SAE work, both administrative and technical.

A citation to Colonel Alden from the Automobile Old Timers five years before his death said of him:

"Colonel Alden smokes a very peaceful pipe, but his daily yield of peacetime engineering—'get-up-and-git'—is militant and dynamic. He prays for peace, but keeps his powder dry! . . . . Cold type cannot voice our continuing gratitude for the warm personal traits—the friendly, flesh-and-blood attributes which are basic to his vigorous leadership."

Table 1—Physical Properties of Alcoa 142 Alloy at Room and Elevated Temperatures

	75 F	500 F	600 F
Tensile Strength, psi	28,000	18,000	8000
Yield Strength, psi	25,000	13,000	4000
Elongation, %	2.0	4.0	15.0
Brinell Hardness	120	54	45

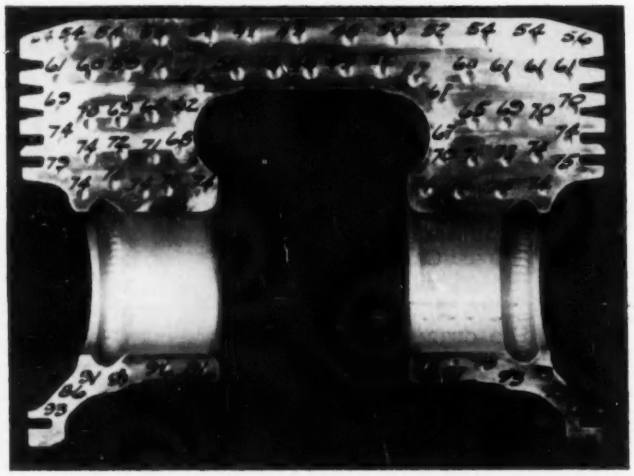


Fig. 1—Cross-section of an aluminum alloy aircraft engine piston with Brinell hardness values

HOW

PISTONS can be cooled in several ways. But before deciding on a cooling method, temperatures reached in an uncooled piston should be known. The Brinell hardness method is the simplest, least expensive method for determining temperatures and produces sufficiently accurate results.

With the Brinell hardness method, pistons are made of carefully selected aluminum alloy and heat-treated. Reheating in the engine for a given time will substantially reduce hardness. Top piston temperature in any location, when in operation, can be determined from time-temperature-hardness curves. These curves represent data accumulated over many years.

Fig. 1 shows hardness readings on an aircraft engine piston, operated at maximum horsepower for about 10 hr. The temperatures in this piston gen-

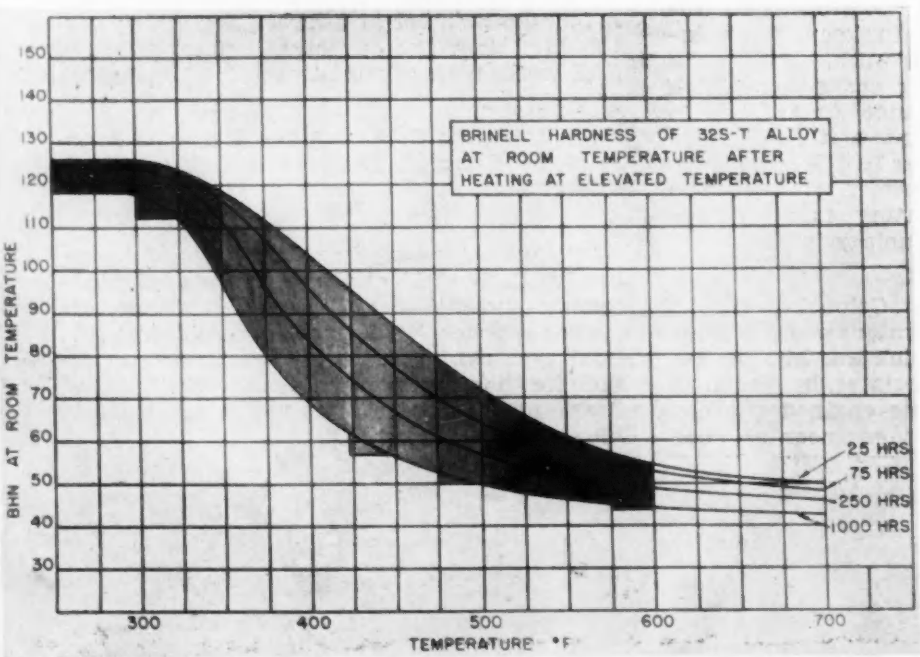


Fig. 2—Time-temperature-hardness curves for converting Brinell hardness readings to temperature values

TO COOL PISTONS

BASED ON PAPER* BY

Frank Jardine

Manager, Development Division, Aluminum Co. of America

* Paper "Piston Cooling and Ring Groove Wear," was presented at SAE National West Coast Meeting, Los Angeles, Aug. 14, 1950.

erally are higher than those in an oil-cooled diesel engine piston. To translate these Brinell hardness values into temperatures, the chart in Fig. 2 is used. This then yields a temperature distribution, such as the one for an aircraft piston shown in Fig. 3.

The method permits evaluation of top operating temperature at any point in a piston. A complete survey, including as many sections as desired, affords a generalization of heat flow paths.

Physical properties of Alcoa 142-T77 alloy sand cast specimens at several temperatures, after holding at testing temperature for 10,000 hr, are shown in Table 1. This comparison emphasizes the fact that any reduction in temperature will improve strength. Hardness also benefits from cooling and is a big help around the top ring in reducing groove wear and pounding. Additionally, the center of the head can better withstand both erosion and thermal cracking.

Fig. 4 further illustrates the effect of working temperatures on hardness. In this chart, hardness of a piston alloy at room temperature is plotted as a function of number of hours exposure at temperature. Temperature range is from 300 to 700 F.

Oil cooling reduces piston temperature. This greatly improves physical properties of the material, reduces ring and ring groove wear, and lessens ring-sticking tendency due to high temperatures. Undoubtedly the new compound oils help considerably in maintaining clean pistons and in reducing ring-sticking troubles. Lower temperatures offer further extensive aid in achieving these ends.

There are at least five ways to cool pistons. Any

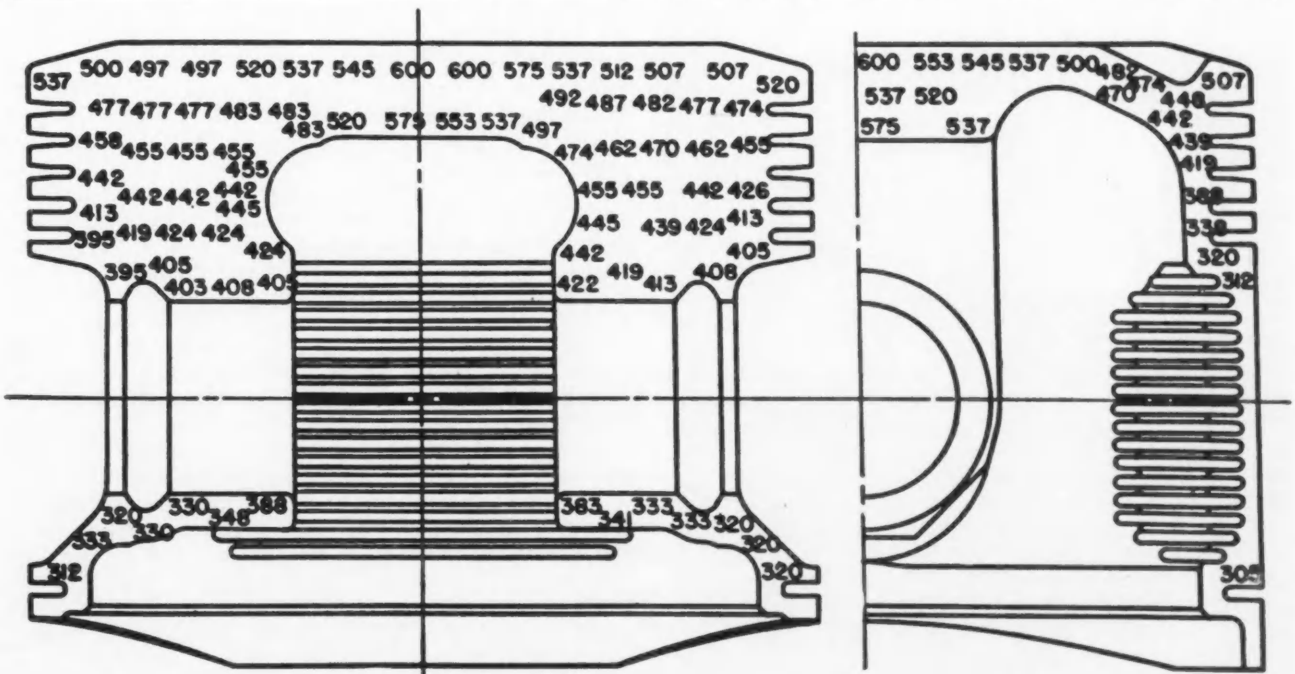


Fig. 3—Cross-section of an aircraft engine piston showing Brinell hardness numbers converted to working temperatures

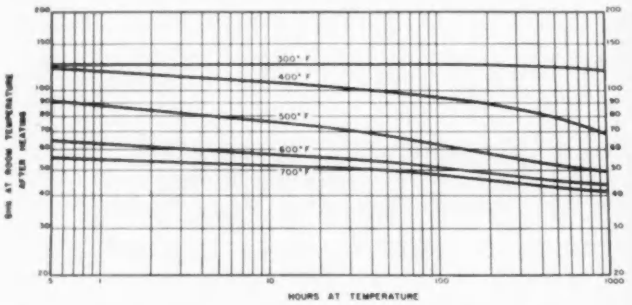


Fig. 4—Time-temperature-hardness curves of Alcoa 32ST alloy shows hardness decrease with temperature increase

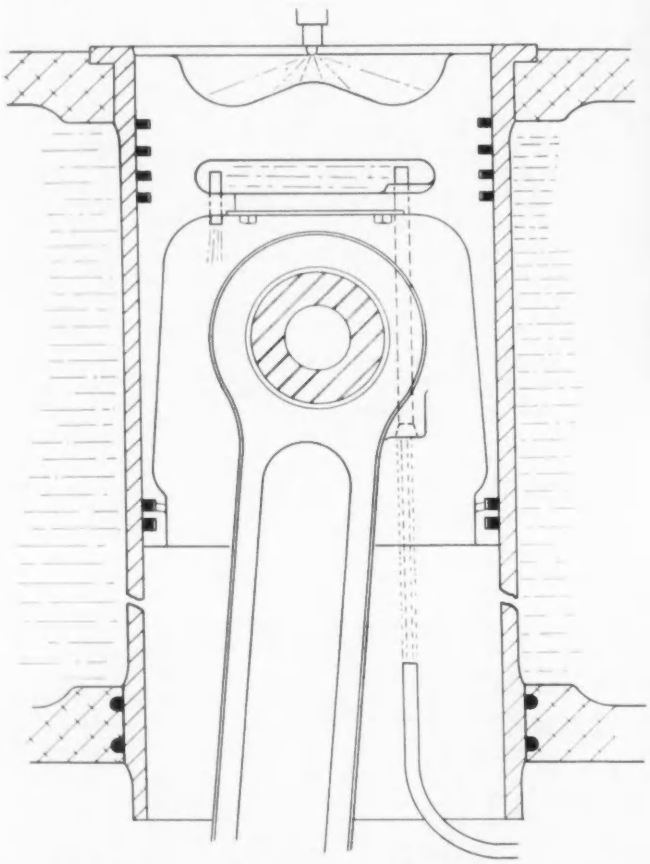


Fig. 5—One method of cooling a piston is with a spray tube

Fig. 6—This diesel engine piston is cooled by the steel coil cast in the ring belt area

design selected must deliver enough oil to the areas to be cooled at all times. Evidence of failure to circulate cooling oil at certain speeds has been seen in systems used in the past. In others, improper valving at higher speeds reduced the quantity of oil delivered to the inside of the piston head.

Amount of oil delivered to the cooling surfaces varies from 50 to 300 gal per hr in different engines at pressures of about 50 psi. Reduction in piston temperature through oil cooling varies from 30 to 200 F, depending on the type of cooling used and amount of oil supplied.

A 100 F reduction in maximum temperature achieved with a given cooling system will greatly improve physical properties of the alloy at prevailing temperatures. Data shown demonstrate this.

One way of providing an oil supply, that is reliable and probably the cheapest, is to use a spray directed up into the piston from a pipe attached to the side of the crankcase. See Fig. 5. The oil can be delivered to the hottest part of the piston in satisfactory quantities at all times. Flow is not materially influenced by inertia forces as in the next method discussed. The piston can be conventional in design and made at a minimum cost.

Delivering oil through the crankshaft and connecting rod to the pistons can be very satisfactory. But it is more expensive than the previous method and requires care to eliminate the effect of reciprocating and rotating motion on the oil flow.

Fig. 6 shows another type oil-cooled piston using a steel tube cast in the ring belt section. Large-size pistons of this type are being used successfully. This design is most effective for ring cooling. Any attempt to cool the center of the piston head in this way would make for a more expensive product.

The two-piece piston in Fig. 7 has the same general circulation path, but has better cooling around the top ring. Note that the upper side of the top ring is effectively cooled in this piston, but no effort has been made to cool the center of the head. This could be done by drilling holes transversely registering with the oil feed passage.

The piston is machined to provide cooling oil passages behind the rings, and an aluminum ring is shrunk on and welded in place. It is important

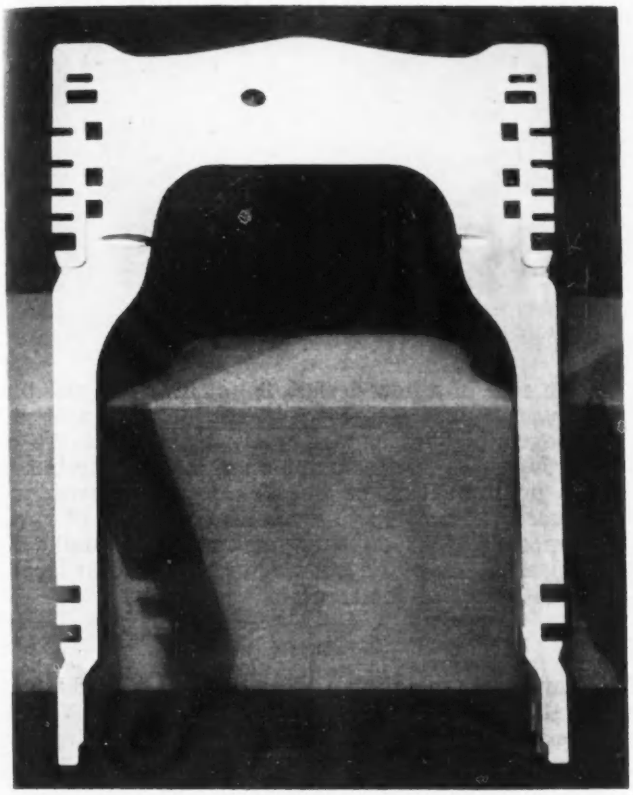


Fig. 7—The shrunk on and welded ring carrier affords the means for cooling this diesel piston

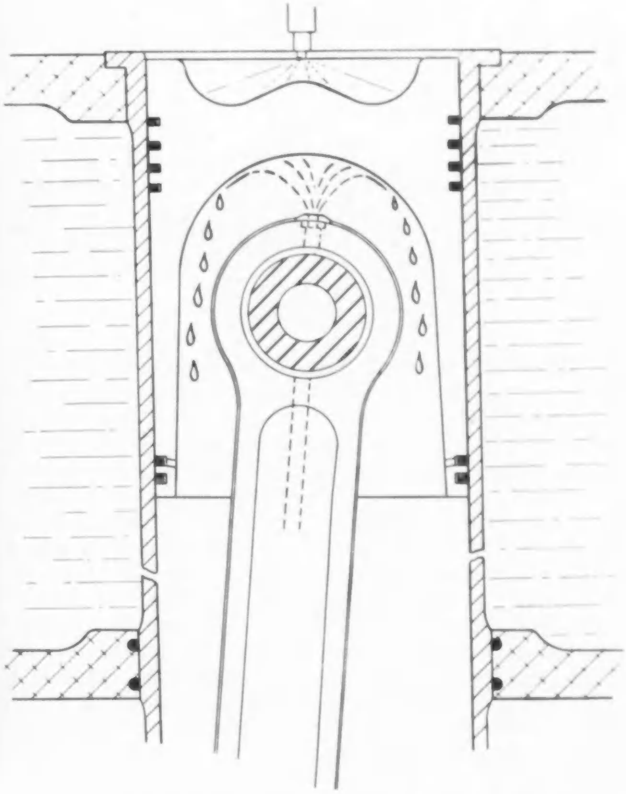


Fig. 8—An oil spray cools the piston in this case

that a good weld be obtained.

The piston in Fig. 8 is cooled by an oil stream delivered through the upper end of the rod. Proper functioning requires a careful design of nozzle together with ample oil supply passages and pressures.

Fig. 9 shows a piston with a baffle which traps the oil in the piston after it has been delivered through the rod. The oil is allowed to gather in the piston and to discharge through an overflow pipe. This method has proved effective, but hardly as good as other systems that circulate more oil and permit cooling closer to the critical areas.

To get still longer ring groove life, a cast-iron insert can be cast into the piston to provide a harder material in which the piston ring can be carried. This gives greater serviceability, but at considerable cost increase. Insert material can be a good grade of piston-ring iron or Ni-Resist iron. It can be bonded to the aluminum or not bonded.

With any oil system, these are the important features to consider: generous oil supply; a quick return; supply of oil to the entire head area as close to the rings as possible; and oil delivery to the piston under all speed and load conditions to insure satisfactory cooling under maximum temperature conditions.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

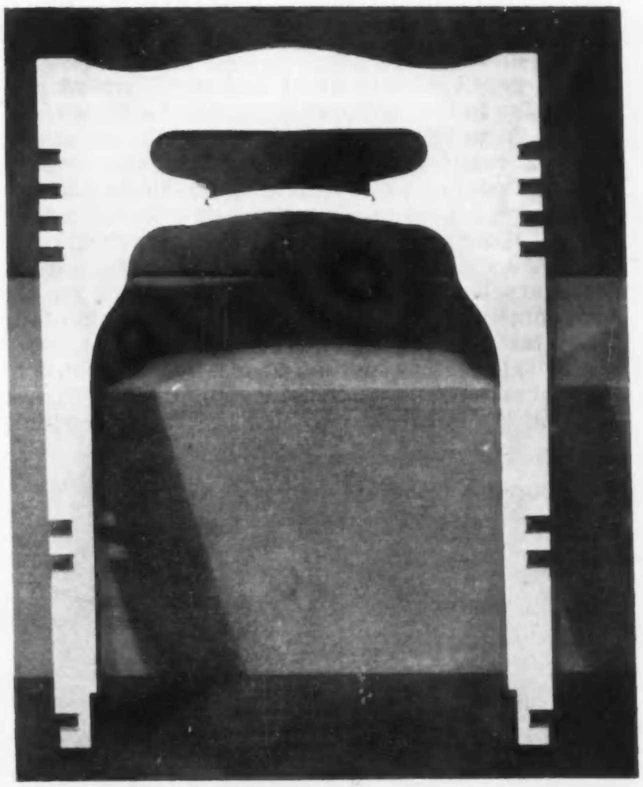


Fig. 9—Known as the cocktail shaker oil-cooled piston, this design traps the oil in the piston

Flight Characteristics at

DEVELOPMENT test flying of a prototype airplane is playing an ever-increasing role of importance in the ultimate design of high-performance military aircraft. When a prototype aircraft is rolled out of the experimental shop for its initial test flight, it is far from finished. The first flights invariably reveal numerous shortcomings in performance, stability, control, and handling characteristics, many of which are of a limiting nature; that is, they are sufficiently serious to prevent the pilot from achieving the estimated design performance. Many months of intensive design effort by engineers and shop personnel have set the stage for an all-out development, modification, and flight test program that will frequently tax their ingenuity and energy to a far greater degree than did the initial design work.

This discussion is concerned with such a development program for one particular type of airplane and for one particular flight characteristic—the flying qualities at high subsonic Mach numbers. Fig. 1 shows the airplane as it was when first flown and before the modifications were made and Fig. 2 shows it in its final configuration.

As a result of this flight test development program, the following conclusions can be drawn:

1. It is possible, by a series of modifications, to effect a relatively large increase in the limiting Mach number of a new airplane. In the case of this airplane the best modifications resulted in an almost 30% increase in limiting Mach number.

2. With specific reference to the high Mach number characteristic, there is a definite need for the development of satisfactory instrumentation and flight test technique. The use of tufts is not a wholly satisfactory method of locating the cause of roughness or separation. It generally requires a chase airplane of comparable performance, which, in the case of a new design, is not always available. The use of accelerometers in conjunction with an oscillograph gives a good quantitative measure of the roughness at any point on the airframe but it gives no indication of its source. This technique was used extensively to evaluate the effect of various modifications on the roughness and shake of any part of the plane but was of little use in locating the source of the trouble.

General

Some pilots refer to an airplane with disturbances at high Mach numbers as having the Machs. Sometimes the Machs occur in one part of the airplane and sometimes in another. As improvements are made the Machs disappear from one part of the airplane and appear in another part.

The achievement of satisfactory flight characteristics at high subsonic Mach numbers represents a relatively new field of endeavor for the aeronautical engineer. Consequently, there has been a great deal of improvising in both the development and the flight test techniques, as is evidenced by the various modifications attempted. In general, relatively large gains were made from minor modifications at the start of the program when the limiting condition occurred at low Mach number. However, as the limiting Mach number approached the design speed of the airplane more drastic changes were required to achieve even a small gain.

Early Flights

Early in the program a limiting shake of the entire airframe was encountered. Airframe shake was defined as the roughness that the pilot feels in the seat as a motion of the entire airframe in contradistinction to the roughness or oscillation of any

Fig. 1—Original configuration of prototype airplane

Fig. 2—Final configuration of airplane

HIGH Mach Numbers

EXCERPTS FROM PAPER* BY

V. Outman and G. S. Graff, McDonnell Aircraft Corp.

* Paper, "Flight Characteristics at High Mach Numbers," was presented at the High-Speed Flight Symposium, IAS-SAE, New York City, March 16, 1950.

particular control surface, which is felt through the control stick or rudder pedals. It must be admitted that airframe roughness so defined could be caused by control surface roughness, or vice versa. Indeed, it was extremely difficult throughout the program to separate the two phenomena; so much so that there is still considerable difference of opinion as to what was shaking what, and why. By flying the airplane at various altitudes up to the speed beyond which the pilot considered it unsafe to fly, the trouble was determined to be a compressibility phenomenon and not due to indicated air speed.

To discover what part of the airframe was causing the trouble, tufts of regular knitting yarn were fastened with scotch tape to the wing and tail surfaces. Photographs of the tufts in flight were made by the pilot of a chase airplane. It was not exactly necessary to have a record taken during flight because some indication could be obtained by observing the tufts that blew off during flight. The region of disturbed flow was clearly indicated by the absence of tufts.

The most critical section was at the root of the wing and the intersection of the horizontal and vertical tail, primarily on the upper surface. In order to improve these conditions a number of modifications were made. The trailing edge angle at the wing root was very large and, to obtain better flow conditions, the trailing edge angle was reduced considerably by a fairing. Another change was a dorsal fin. The idea here was to reduce the thickness ratio of the vertical tail and to move the peak pressure on the horizontal tail away from that on the vertical tail. Changes were also made to the leading edge by applying a fillet. Observations made from a chase plane showed the flow from the side of the fuselage to sweep up near the end of the plane. To improve this condition a so-called spray strip was put on the fuselage to try to keep the flow straight. The flow from the canopy was suspected so tufts were mounted to indicate any disturbance that might be coming from the canopy and hitting the tail. A lagging or antibalance tab ratio was used on the elevator. A trailing edge fillet mounted on the horizontal tail and fairing back onto the rudder was applied. It was recognized that 15-deg dihedral in the horizontal tail made the condition at the intersection more critical, therefore it was reduced as much as the particular structure permitted. After making all these changes the rudder roughness was still a limiting factor but at a Mach number 20% higher than for the configuration first flown.

These changes had another more significant effect. Instead of being limited by rudder roughness the airplane encountered aileron difficulties. High-frequency, single-degree-of-freedom oscillations of the ailerons, popularly called "buzz," have been encountered on several other high-speed aircraft. The roughness of this airplane seldom exhibited the harmonic characteristics of the "buzz" phenomenon but manifested itself instead as an irregular roughness of the aileron controls with a tendency toward lateral instability and wing heaviness. At times the various conditions would occur at different altitudes on the same flight. To cure this phenomenon the seal balance was ventilated. Rigging the ailerons up or down was tried. It was concluded that more damping was needed. A friction damper was constructed that required 6 lb on the top of the control

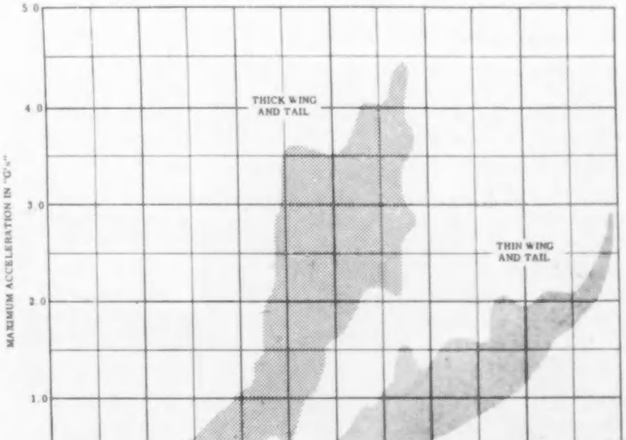


Fig. 3—Variation in acceleration at tip of stabilizer versus Mach number

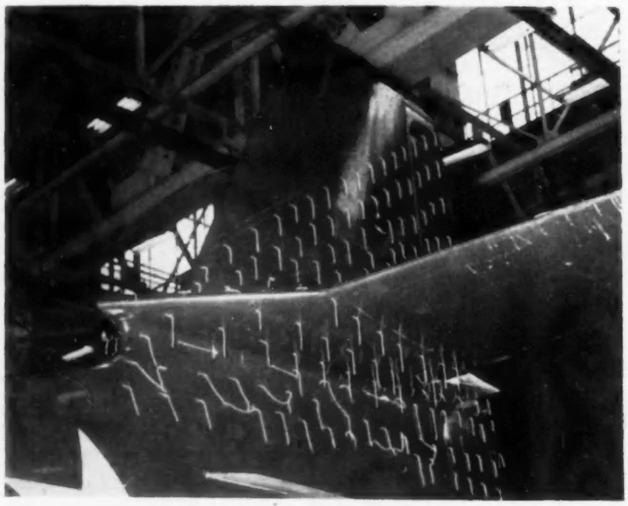


Fig. 4—One modification tried

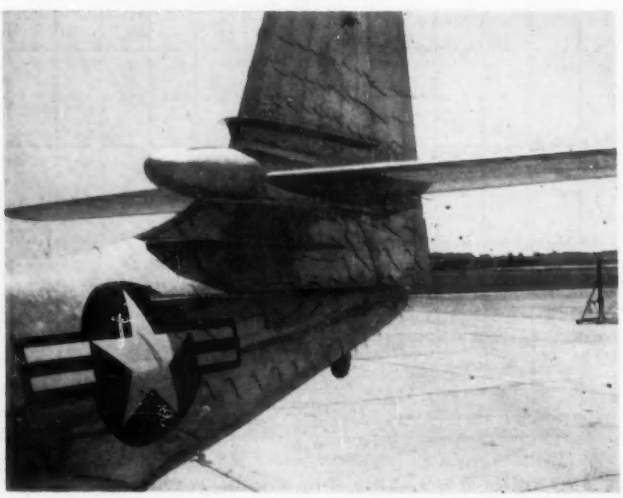
stick to move the aileron. This was all the pilot would put up with. A hydraulic damper was designed and installed.

The design of an aileron power boost system had been started to obtain lower aileron forces, so it was installed and tested. After improving this condition the Machs were chased out of the wing but they reappeared in the airframe and rudder. Airframe shake and rudder buffeting were again the limiting factors. Also, at this point tuck-up was encountered. This is a phenomenon in which the plane doesn't want to dive steeper in spite of the pilot using full strength to push the stick forward and rolling in full down trim tab.

An all-out program got underway to improve rudder roughness and airframe shake. A bullet fairing was applied with and without a tail fairing. The granddaddy of all tail fillets was installed. In an attempt to get three-dimensional flow a very large bullet was installed. A variation of the nose shape was also tried.

Because of the large amount of up-flow in the region of the horizontal tail, a horizontal separation plate was attached. The idea was to prevent the up-flow and perhaps to avoid separation on the upper surface of the horizontal tail.

Fig. 5—One of most drastic configurations



Thinking that combinations might be helpfu[l], we attempted to combine both the bullet and th[e] horizontal separation plate. We then applied th[e] horizontal separation plate to the dorsal fin.

On all of these modifications we had been recording the accelerations in the tail versus Mach number. Fig. 3 shows the variation in g at the tip of the stabilizer versus Mach number. The vibrations in an early version are compared with one of the later configurations.

Tuft studies at high Mach numbers showed that wing and tail surfaces should be thinner, so this was done by building a new outer panel and modifying the trailing edge of the inner wing. In making this change we also found it possible to reduce the horizontal tail dihedral to zero degrees.

With these wings and tail surfaces, other modifications were tried. Carrying the horizontal separation plate idea still further, the modification in Fig. 4 was tried. As we were not completely sold on the uselessness of a bullet, another was tried on the airplane in this configuration. In addition we went full out on the idea of using spray strips to keep the flow from sweeping upward. Fig. 5 shows one of the most drastic configurations.

Even though the reaction experienced by the pilot is different and the disturbing flow occurs on different parts of the airplane, there is still one basic cause. As the Mach number is increased the pressure distribution on various parts of the plane changes such that the pressure gradient on the aft portion of the body increases. When a critical gradient is reached separation occurs. This separation creates roughness, which is transmitted through the plane to the pilot. It is sometimes transmitted through the airframe itself and at other times, when the separation occurs on a control surface, it is transmitted through the controls. This accounts for the various types of roughness or shaking experienced by the pilot.

As Mach number increases the change in pressure distribution, both before and after separation occurs, also changes the forces and moments exerted on the plane. This can be an unsteady condition in which the plane is oscillated about any one of the three axes. On the other hand, it can also be a steady-flight condition at a given Mach number in which the trim of the airplane changes. This retrimming condition can exist as a result of the change in the basic moments exerted on the plane or due to the change in hinge moments or control surface effectiveness, which may be altered due to the variation in pressure distribution and separation. Thus, no matter what form of disturbance occurs and no matter what part of the plane causes the trouble, the basic change is due to these compressibility effects.

At the end of this program airframe shake and rudder roughness had not been eliminated and the tuck-up tendency was still present but to a degree that was not dangerous. It was more of a safety feature in that it prevented the pilot from getting into other troubles.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

ALL ABOARD !!

SAE National Diesel Meeting gives railroaders and diesel men chance to argue mutual problems. Data promise better economy, equipment, performance

THE 1950 SAE National Diesel-Engine Meeting was definitely a railroad affair. The 644 that attended the meeting—a record number—included representatives of all the leading railroads, and suppliers of engines, accessories, and petroleum to the railroads. They were given a nourishing diet of material designed to help them solve their diesel problems.

Special emphasis was placed on ways in which the engineer is helping the railroads to attain greater economy and thus, as one speaker put it, "help them out of one of their primary dilemmas—how to carry passengers, baggage, mail, and express without deficits."

One session, for instance, was devoted to a complete technical description of the new Budd diesel railway car—a self-propelled unit built especially to help railroads give better and more frequent service with a minimum of capital outlay and at the lowest possible operating cost.

Then, at the best attended (over 400) and most controversial session, railroad representatives and oil company engineers told how they were cooperating in a program aimed at improving the oil used in diesel-engine crankcases—especially how to extend oil mileage between drains.

Finally, came data on another railroad problem—the effect of variations in altitude on horsepower available for tractive effort.

Budd Car

The Budd RDC railway car, according to a company spokesman, is a light-weight, stainless-steel structure with the car body primarily a modified box beam. It uses two 275-hp GM 6-110 diesels. It employs a torque-converter drive with reverse gear, disc brakes, and antiwheel-slide control equipment.

The passenger version is air conditioned, has seats of the walkover type for quick turnabout, which are covered with tough, easy-to-clean Koroseal. Fluorescent ceiling lights are used, and the floors are covered with long-lasting Terraflex tile.

So the power unit and equipment would not encroach on revenue space, they were designed to fit under the car floor but, at the same time, be accessible for maintenance and be completely replaceable in less than two hours—to keep maintenance costs to a minimum and availability to a maximum.

This rapid change is made possible, it was said, by the use of quick disconnects for all engine ser-

vices, simple attachment of the power unit to the car body, and a special dolly for handling the unit.

Diesel power was selected, it was reported, because of its high efficiency, low cost, less hazardous fuel, and general all-around ruggedness, together with practical horsepower/weight ratios.

Two smaller engines are used instead of one big unit for several reasons. For one thing, they are considered to give greater operating reliability because if one unit isn't working, the run can still be completed at a reasonable speed. The two 275-hp units are each light enough to permit easy handling, so that complete engine changes can be made quickly, using stock space engines.

Thus, since the whole car is designed on the philosophy of no overhaul of power unit on the car and extremely rapid engine change, the Budd speaker emphasized that if false economy or initial lack of foresight prevents a railroad from buying space engines, one of the biggest contributions to car availability will have been lost.

It was also felt that, due to the greater industrial demand for 275-hp engines than for larger units, it would be possible to benefit from automotive production methods on the larger quantity production of a basic engine. The result is a sizeable reduction in the initial engine costs as well as the cost of parts and space power units.

Disc brakes are used, it was said, because of the record they have made in quick-stopping ability, low maintenance cost, and the elimination of heat-checked wheels, although some engineers at the meeting were a bit skeptical that the disc brake would stand up under the tough conditions of railroad operation.

One unusual scheme, pioneered by Budd, was described. Four standard floor plans are offered to purchasers of any number of cars at a fixed price announced in advance, instead of the age-old system of custom building cars to every different railroad specification. Such a procedure, it is claimed, results in tremendous cost savings, shortens delivery times, and still provides for a rather wide variety of operating requirements.

The diesel used on this car is a 6-cyl, 2-cycle unit of 660 cu in. displacement. Although generally this engine operates with the cylinder block vertical, in this application the block has been inclined 70 de from the vertical to permit under-floor mountin

It was emphasized that excessive wear, whic might be expected because of the angular installa tion, does not occur, since the direction of engin rotation is such that the gravity force of the pisto subtracts from the piston thrust.

Each engine has its own cooling system, which i installed so as not to encroach upon revenue space is independent of car motion, is a source of heat fo the car, and absorbs minimum power in the coolin fan. The system is able to function without antifreeze because of several features described at the meeting. The bypass valve does not modulate the flow through the radiators. It is either fully open (meaning no radiator flow), or fully closed (giving 100% radiator flow). This action, plus self-draining, prevents freeze-up of the radiator in subzero weather. During layover, antifreeze protection is provided by maintaining the water in the tank at 140 F by means of a stand-by heating system.

The hydraulic torque converter was chosen for use on this car, it was reported, because:

- The present-day mechanical clutch can't take the tremendous starting loads of these cars without considerable slipping.
- Mechanical drives have clutch problems and lack of flexibility, especially for remote controls.
- Although electric drives are satisfactory, they add weight and cost and reduce fuel mileage.
- The efficiency of the hydraulic torque converter drive with mechanical reversing unit exceeds the electric drive efficiency over the major portion of the operating range as long as the power from the engine is to be transmitted to a single axle; thus, the torque converter can be a good, effective means for the transmission of power from the prime mover to the driving axles of the railcar.
- The torque converter has flexibility suitable for multiple installations up to a certain horsepower rating, depending primarily upon the number of driving axles required for the job.

It was felt by its designers that the Budd railcar transmission combines the low cost, light weight,

Turn to Page 62

The meeting was under the leadership of (left to right): T. A. Scherger, chairman of Chicago Section; A. H. Fox, vice-president for SAE Diesel-Engine Activity; R. W. Seniff, meetings chairman for SAE Diesel-Engine Activity Committee; J. A. Nelson, general chairman of the meeting

At the Dinner

Speaker Gen. Levin H. Campbell

Toastmaster Harvey T. Hill

GEN. LEVIN H. CAMPBELL, JR., executive vice-president, International Harvester Co., and chief speaker told his audience of 512 SAE members and guests, "I am a great admirer of engineers. It would be strange if I did not admire men of your profession for I have had the privilege of working closely with engineering people . . . , first in the Army and now as a civilian . . . By your deeds I have known you."

General Campbell went on to stress the importance of the engineer as a dispassionate dealer in facts. The engineer and the capitalist, working in partnership, are responsible for our present standard of living, the General said. He concluded by saying that if we are to keep the advantages of our system, we must do so through our products and services, and every product and many of our services begin on the drafting board of the engineer. "Looking ahead, I believe I see great new responsibilities for the engineer," he said. "Looking backward, at your history of accomplishment, I am sure you are equal to the task."

John A. C. Warner, SAE general manager, spoke in the absence of SAE President James C. Zeder, who was unable to attend.

Warner recalled how the SAE had responded during World War II with all its vast resources of engineering knowledge to help solve problems put to it by Gen. Campbell's Ordnance Department, and others. He reaffirmed that in this new war effort the SAE will not be found wanting. Although many of the current problems are more complex, he said, SAE is better prepared than before. "In all humility and with a full sense of the deeper values," he said, "I know that the SAE will live up to our promise to our Government—whatever you want to call it—peace of preparedness—cold war—hot war— the SAE is in there pitching with everything it's got!"

SAE Secretary and General Manager
John A. C. Warner

and efficiency of the mechanical transmission with the smoothness and simplicity of the electric type.

A study of operating cost data showed that the diesel-hydraulic drive costs only 41.5% of that on the steam car.

Oil Improved

Reports were heard from both the railroad and the oil company participating in a cooperative test program designed to improve crankcase oils and extend the mileage between drains. Result of work to date is a possible solution to one problem that confronts the railroads, namely, how to maintain the quality of the heavy-duty oils in their diesels without making frequent crankcase drains.

This seems to resolve around finding, first, a good dispersancy test that will tell the condition of the oil and, also, a method of maintaining the proper quantity of active additive agent in the oil.

A test that determines with reasonable accuracy the active additive content of a crankcase oil at all times has not been fully developed. Two methods were reported, however, that are helping to solve the problem. In one, called the blotter spot test, a drop of the oil to be tested is put on an absorbent filter or blotter paper and allowed to dry for 5 hr. For the heavy-duty oil being used, the spots were made up generally of a black spot at the center and around that an oily area. The nature of the black spot makes possible an estimate of the dispersive characteristics of the oil, while the color of the oily outer area indicates roughly the extent of oxidation.

Best results were obtained in the tests when a series of samples was studied. This was also true of dark-field microscope inspections, which were reported as giving additional help in observing the extent of dispersion and/or particle agglomeration of the oil.

One discusser pointed out that further aid in the evaluation of dispersancy will probably come as the result of research now being done with the electron microscope, coupled with spectrographic analyses.

How to keep the additive content of the oil at the proper level is a problem that has not yet been solved to the complete satisfaction of all, the meeting showed.

All agreed that the best answer to the problem would be an additive that would remain effective for unlimited mileage, but such an additive has not yet been found.

The simple way, as one oil man put it, would be to suggest that the engine builder's recommendations be followed, that is, drain at 30,000 miles, but, he said, "The railroad people are conscious of the fact

Around the Meeting

AN ORGANIST provided appropriate music during the general cocktail party and during dinner. ("Stouthearted Men" when the Speakers' Table guests marched in.)

THE THREE SEPARATE INSPECTION TRIPS, on the meeting's final (and cold) day, began with the game of block the traffic and find the bus. One trip was the Sinclair Research Laboratory at Harvey; another to Burlington Railroad Maintenance Shops in Chicago; and another to the General Motors Electro-Motive Plant in LaGrange. Featured at LaGrange was a huge "blue-print for better locomotives" display. (See accompanying photograph.) Here SAE guests sat in full-scale locomotives, played "engineer" and "fireman," worked throttles, bells, signals, and controls.

RAILROAD ENGINEERS. Wandering through the Chicago audience, your roving reporter ran into top engineers from such railroads as: Pennsylvania; Chicago & North-Western; Terminal Railroad Association of St. Louis; Tennessee Central; Wabash; Gulf, Mobile, & Ohio; Frisco; Burlington; Erie; Lackawana; Ill. Terminal; Seaboard Air Lines; Grand Trunk; Baltimore & Ohio; Texas & Pacific; Chicago & Eastern Ill.; Monon; St. Louis-San Francisco; Chicago, Milwaukee, St. Paul, & Pacific; Santa Fe; Elgin, Joliet, & Eastern.

SPEAKERS' TABLE was a really outstanding feature of the meeting—both as to quality and size. With very few omissions, as Toastmaster Harvey T. Hill said, "It's a Who's Who of top engineering talent in the diesel-engine industry."

JOKE-OF-THE-MEETING was told by Toastmaster Hill: "It seems that trouble developed at one time in Paradise. Eve became jealous of Adam. She suspected that he had another woman in a corner of the Garden of Eden where he frequently went hunting. Adam tried to reason with her. He said, 'Darling, you know that you are the only woman and I am the only man on earth. So how can you possibly be jealous?' Eve seemed to be satisfied—at least until that night when she awakened him by poking his chest. 'For heaven's sake what are you doing?' he cried. 'I'm counting your ribs,' was her determined reply!"

that it costs money to drain crankcases. The labor cost of draining a railroad diesel crankcase varies from $10 to $50, depending upon the job done . . . . If the oil can be run longer with satisfactory performance, the railroads are going to run it longer. Our job is to help them determine the quality of the oil in the crankcase at all times and work out the best method for maintaining that quality."

The method described as eminently successful in the case of the cooperative program consists of adding 15 gal of a concentrate, made up of base oil plus five times the usual amount of additive, to the lubrication system at each 5000-mile filter change.

With this procedure, called crankcase fortification, engines were operated with extended oil mileages. For instance, one engine ran for 136,698 miles and another for 118,474 miles before the oil was drained. Periodic inspection of these engines showed them to be satisfactorily clean.

Lubrication with fortification was said to eliminate at least two oil drains per engine per year. In fact, this railroad expects to reduce its new lubricating oil costs for its fleet of 50 high-output freight engines about $8000 per year and to reduce the accumulation of crankcase draining about 17,500 gal per year.

One oil man cautioned the railroads to use only the concentrate supplied for the particular oil being used. He said that too much additive introduces various problems. For instance, they may not release contaminants to the filter, which would eliminate an important part of the lubrication system. If the filter medium is changed to clay or some other material that will remove the finely dispersed contaminants, then the additive is also removed, and the oil rapidly approaches a straight mineral oil in composition.

Another method of securing extended oil mileage was described that consists of increasing the amount of additive contained in the new oil, so that the amount of additive in the crankcase is always kept above the minimum needed. This system was considered better than crankcase fortification in that it eliminates the extra petroleum product that must be purchased and handled. Also, inasmuch as make-up oil is usually added every 500–1000 miles, the concentration of effective additive in the crankcase should remain more nearly constant than when a large amount of additive is added at 5000-mile intervals.

It was pointed out, though, that the addition of higher additive strength oil to a high oil-consuming engine would do little good. This speaker felt that the economics of whether it would be less expensive to fortify the crankcase oil with additive concentrate or go to the higher additive strength oil only could be worked out by the railroad in cooperation with its oil supplier.

The maintenance of absolute engine pan cleanliness, to the bare metal, is not the goal, according to another discusser, who explained that all the major oil companies try to build into their oil a controlled lacquer-coating tendency to cover all parts to be lubricated, as well as to offset metal-to-metal contact, metal activity, and its catalytic effect on the oil.

It seems to be more difficult to derive a simple correction factor for the performance of diesel engines

Under the general chairmanship of **J. A. Nelson**, the following served as chairmen of three technical sessions of the SAE National Diesel-Engine Meeting: **F. G. Shoemaker, W. K. Simpson**, and **E. E. Bryant.**

This report is based on discussions and seven papers . . . New Budd Diesel Railroad Car RDC-1 with Torque Converter Transmission: "The Car," by **Benjamin Labaree**, The Budd Co.; "The Torque Converter and Transmission," by **R. M. Schaefer,** Allison Division, General Motors Corp.; "The Diesel Powerplant," by **Vernon Schafer, Jr.,** Detroit Diesel Engine Division, General Motors Corp.; . . . . "Heavy-Duty Oils in Railroad Diesel Engines," by **W. E. Lasky, M. A. Hanson,** and **H. E. Frank,** Gulf, Mobile and Ohio Railroad Co.; "Estimating Additive Depletion in Heavy-Duty Oils Used in Railroad Service," by **L. A. Wendt,** Shell Oil Co.; "Altitude Effects on Two-Cycle Automotive Diesel Engines," by **R. W. Guernsey,** Detroit Diesel-Engine Division, General Motors Corp.; and "Altitude Performance of the Electro-Motive 567 Engine Under Railroad Conditions," by **H. W. Barth, D. M. Lyon,** and **R. B. Wallis,** Electro-Motive Division, General Motors Corp.

All of these papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be printed in full in SAE Quarterly Transactions.

at altitude than it was for carbureted mixture engines. As the authors of one paper put it, "The performance of a mixture engine, operating at substantially constant air/fuel ratio, will vary directly with air density along one of the straight lines, for example, the maximum-power line. In the case of the 2-cycle diesel engine, operating with a wide variation in air/fuel ratio, there is a considerable range of altitude where the power changes but slightly, as the air density decreases. The lower rated engines are the least affected by changes of altitude. In the case of ratings below 50 cu ml per stroke, the power output actually increases somewhat up to rather high altitudes. A diesel engine that is rated close to its maximum will be far more sensitive to atmospheric conditions, possessing a sensitivity of the same degree as that of a carbureted mixture engine."

Two approaches to this problem were presented. In the one case tests were run on a model 567 GM 16-cyl, uniflow, 2-cycle engine used on railroad locomotives. This engine showed marked differences in power output at different elevations. For instance, there was practically no change in horsepower from sea level to a density altitude of 2500 ft, whereas between 2500 and 5000 ft a decline in power became evident. It reached a rate of decline of 20 hp per 1000 ft for this engine above 5000 ft.

The other paper discussed a method developed for correcting diesel-engine performance for atmospheric conditions. In this case it is necessary to know the complete performance of an engine at only one density condition in order to derive the performance at any other density. Further, the constant-speed fuel fish-hooks, carried out to a point where power begins to fall off at an overrich air/fuel ratio, contains the information needed to make the correction.

It was found that the GM 6-76 2-cycle diesel engine upon which tests were run follows a fundamental pattern of performance at various altitudes, which is brought out by analyzing the test data along lines of constant overall air/fuel ratio.

1951 SAE

Hotel Book-Cadillac

Monday, Jan. 8

10:00 a.m.

A. H. FOX, Chairman

The Low-Temperature Starting and Operation of Diesel Engines
—A. W. SLOAN, A. C. SCURLOCK, and D. P. HERRON, Atlantic Research Corp.

Combustion Characteristics of Diesel Fuels as Measured in a Constant Volume Bomb
—R. W. HURN and K. J. HUGHES, U. S. Bureau of Mines

(Sponsored by Diesel Engine Activity)

10:00 a.m.

R. D. KELLY, Chairman

Air Transport Developments 1949-1950 and a View to the Future
—R. D. SPEAS, A. V. Roe Canada Limited

How Large Can the Gaps Be?
—C. E. SWANSON and J. W. MILLER, Northwest Airlines, Inc.
(To be presented by title)

(Sponsored by Air Transport Activity)

2:00 p.m.

C. G. A. ROSEN, Chairman

Business Session of Diesel Engine Activity

The Current Status of Automotive Diesel Engine Design and Performance in Great Britain
—C. B. DICKSEE, A. E. C. Limited

(Sponsored by Diesel Engine Activity)

2:00 p.m.

W. H. WORTHINGTON, Chairman

Business Session of Tractor and Farm Machinery Activity

Symposium—Liquefied Petroleum Gas as Tractor and Automotive Fuel

Liquefied Petroleum Gas for Motor Fuel—Future Supplies and Distribution
—R. C. ALDEN and F. E. SELIM, Phillips Petroleum Co.

Engine and Carburetion Equipment Requirements for Liquefied Petroleum Gas Fuel
—A. J. ST. GEORGE, Ensign Carburetor Co.

Comparative Operating Data of Tractors Using Gasoline or Liquefied Petroleum Gas Fuel
—M. J. SAMUELSON, Minneapolis Moline Co.

(Sponsored by Tractor and Farm Machinery Activity)

8:00 p.m.

L. A. RODERT, Chairman

Business Session of Air Transport Activity

Some Developments for Safer Aircraft
—A. L. MORSE, Civil Aeronautics Administration

Observations on Flight Safety
JEROME LEDERER, Flight Safety Foundation, Inc.

(Sponsored by Air Transport Activity)

Tuesday, Jan. 9

9:30 a.m.

D. F. CARIS, Chairman

Presentation of HORNING MEMORIAL MEDAL to D. P. BARNARD by A. M. ROTHROCK, Chairman, Horning Memorial Board of Award

Horning Memorial Lecture—"The Role of Fuel in Engine Development"
—D. P. BARNARD, Standard Oil Co. (Indiana)

Trends in Motor Fuel Volatility
—W. M. HOLADAY and D. P. HEATH, Socony-Vacuum Oil Co., Inc.

(Sponsored by Fuels and Lubricants Activity)

9:30 a.m.

R. J. WOODS, Chairman

German Aircraft Manufacturing Methods
—AUGUST BRINGEWALD, Republic Aviation Corp.

The Design and Development of the Lockheed Constitution
—W. M. HAWKINS and R. L. THOREN, Lockheed Aircraft Corp.

(Sponsored by Aircraft Activity)

2:00 p.m.

A. O. WILLEY, Chairman

Business Session of Fuels and Lubricants Activity

A New Look at Motor Gasoline Quality—Carburetor Icing Tendency
—J. F. KUNC, Jr., J. P. HAWORTH, and J. E. HICKOK, Esso Laboratories, Standard Oil Development Co.

Series 2 Oils Pay Their Way
—W. G. BROWN and F. E. KRONENBERG, Caterpillar Tractor Co., and J. A. EDGAR and F. A. M. BUCK, Shell Oil Co.

(Sponsored by Fuels and Lubricants Activity)

2:00 p.m.

B. R. TEREE, Chairman

Business Session of Aircraft Activity

Investigations of Hydraulic Damping
—J. E. CAMPBELL, North American Aviation, Inc.

The Accessory Manufacturer's View of Field Service
—P. H. EMRICH, Vickers, Inc.

(Sponsored by Aircraft Activity)

8:00 p.m. BUSINESS SESSION

President JAMES C. ZEDER in the Chair

Nomination and Election of Members-at-large of Annual Nominating Committee

Announcement of Election of Officers for 1951

Presentation of the Annual Report

Presentation of Life Membership

8:15 p.m.

R. F. STEENECK, Chairman

Business Session of Production Activity

Symposium—Unusual Production Developments
—Summarized by JOSEPH GESCHELIN, Automotive Industries

Increasing Productivity in Production Machining
—MICHAEL FIELD and NORMAN ZLATIN, Metcut Research Associates

Mass Production Lapping Technique
—C. R. MOORE, Chevrolet Motor Division, General Motors Corp.

Developments in Large Closed Die Forging
—E. O. DIXON, Ladish Co.

Mass Marquenching
—W. B. CHENEY and W. C. HIATT, International Harvester Co.

(Sponsored by Production Activity)

Wednesday, Jan. 10

9:30 a.m.

E. H. SMITH, Chairman

The Smitsvonk Low-Tension Capacity Ignition System
—W. BEYE SMITS and P. F. H. MACLAINE PONT, Smitsvonk N. V. Research Laboratory

Ignition Problems in Damp Weather
—H. L. HARTZELL and B. H. SHORT, Delco-Remy Division, General Motors Corp.

Optimum Rate of Voltage Rise for Minimum Energy Loss in Ignition Systems
—L. H. MIDDLETON and M. F. PETERS, Electric Auto-Lite Co.

(Sponsored by Passenger Car Activity)

9:30 a.m.

A. L. POMEROY, Chairman

Low Temperature Lubrication of Aircraft Engines
—SAUL BARRON, Powerplant Laboratory, Air Material Command

Starters for Turbojet Engines
—W. D. DOWNS, Powerplant Labo-

ANNUAL MEETING

Detroit — Jan. 8-12, 1951

ratory, Air Material Command
(Sponsored by Aircraft Powerplant Activity)

2:00 p.m.

JAMES C. ZEDER, Chairman

Business Session of Passenger Car Activity
History and Purpose of the Beecroft Lecture Series—Presentation of Award
—PYKE JOHNSON, Chairman, Beecroft Traffic Safety Engineering Lecture Committee, 1946-1949
Fourth Beecroft Memorial Lecture—Traffic Safety and the World We Live In
—SIDNEY J. WILLIAMS, Assistant to the President, National Safety Council
(Sponsored by Passenger Car Activity)

2:00 p.m.

FREDRIC FLADER, Chairman

Business Session of Aircraft Powerplant Activity
The Irreversible Adiabatic Polytropic Process with Variable Specific Heat and Its Application to Gas Turbine Cycle Analyses
—A. S. LEONARD, University of California
(To be presented by title)

DINNER

6:30 p.m. Wednesday, Jan. 10

Detroit Masonic Temple

8:15 p.m. — Speaking Program

L. I. WOOLSON, Chairman, SAE Detroit Section

Master of Ceremonies—
HENRY FORD II, President Ford Motor Co.
JAMES C. ZEDER, 1950 SAE President
JAMES E. HALE, 1951 SAE Presidential Nominee

Principal Speaker
W. STUART SYMINGTON
Chairman, National Security Resources Board

Very High Altitude Auxiliary Power Unit Developments
—H. F. DUNHOLTER and B. T. SALMON, Consolidated Vultee Aircraft Corp.
Turbojet and Turboprop Engine Controls
—F. C. MOCK, Bendix Products Division, Bendix Aviation Corp.
(Sponsored by Aircraft Powerplant Activity)

Thursday, Jan. 11

9:30 a.m.

J. L. McCLOUD, Chairman

Problems Involved in Joining Sheet Metal for Torque Converters
—H. O. FLYNN, Chevrolet Motor Division, General Motors Corp.
Automotive Applications and Special Features of Synthetic and Natural Rubbers
—J. W. LISKA, Firestone Tire and Rubber Co.
(Sponsored by Engineering Materials Activity)

9:30 a.m.

W. P. MICHELL, Chairman

The Automotive Differential
—L. RAY BUCKENDALE and L. G. BOUGHNER, Timken-Detroit Axle Co.
(Sponsored by Truck and Bus Activity)

2:00 p.m.

H. H. HOOKER, Chairman

Business Session of Truck and Bus Activity
Symposium on Truck Refrigeration
Refrigeration of Delivery Vehicles
—W. E. PETERSEN, International Harvester Co.
Refrigeration of Highway Transport Vehicles
V. M. DREW, Fruehauf Trailer Co.
(Sponsored by Truck and Bus Activity)

2:00 p.m.

F. P. ZIMMERLI, Chairman

Business Session of Engineering Materials Activity
Operational Stresses in Automotive Parts
—ROBERT SCHILLING, Research Laboratories Division, General Motors Corp.
Stresses Imposed by Processing
—O. J. HORGER, Timken Roller Bearing Co.
(Sponsored by Engineering Materials Activity)

8:00 p.m.

E. C. DeSMET, Chairman

Business Session of Body Activity
A Modern All-Aluminum Body Development for Production
Introduction — Chairman DeSMET, Willys-Overland Motors, Inc.
Selection of Materials—J. H. DUNN, Aluminum Co. of America
Spotwelding—E. J. ZULINSKI, Progressive Welder Co.
Engineering, Fabrication and Assembly—C. J. SCHMIDT, Goodyear Aircraft Corp.
(Sponsored by Body Activity)

Friday, Jan. 12

9:30 a.m.

M. E. NUTTILA, Chairman

Maintenance Savings Accomplished Through an Integrated Plan of Precision Testing and Adjustment to Manufacturers' Standards
—A. W. NEUMANN, The Willet Co.
(Sponsored by Transportation and Maintenance Activity)

9:30 a.m.

J. W. GREIG, Chairman

Automotive Fabrics from the Creative Standpoint
—MARIANNE STRENGELL, Cranbrook Art Academy
(Sponsored by Body Activity)

2:00 p.m.

A. H. DEIMEL, Chairman

Engineering of Involute Splines
—G. L. McCAIN, Chrysler Corp.
Fatigue Failures are Tensile Failures.
—J. O. ALMEN, Research Laboratories Division, General Motors Corp.
Planetary Gears for Automatic Transmissions
—D. T. SICKLESTEEL, Detroit Gear Division, Borg-Warner Corp.
(Sponsored by Passenger Car Activity)

2:00 p.m.

J. A. HARVEY, Chairman

Business Session of Transportation and Maintenance Activity
Mechanizing the Garage and Shop From an Economic Standpoint
1. Daily Servicing
2. Preventive Maintenance and Routine Running Repairs
3. Repair and Overhaul

(Sponsored by Transportation and Maintenance Activity)

F&L Men Debate Study Detonation

THE SAE National Fuels and Lubricants Meeting in Tulsa, November 9 and 10, amounted virtually to an intensive course in current thinking on detonation problems.

Excellent antidetonation quality of liquefied petroleum gas permits compression ratios high enough to compensate for the comparatively low heating value of LPG, its proponents and opponents agreed in one session. But debate on whether or not automotive use of LPG is economically justifiable made that the liveliest session of the meeting.

In other sessions—marked by lavish use of technical jargon and care to define the terms—experts reviewed basic knowledge about detonation and the measurement of antidetonation qualities. They reaffirmed that whether or not a particular combination of engine and fuel detonates depends on the fuel, the design and condition of the engine, and the operating conditions. Interspersed with the new data offered to strengthen this contention came news of an electronic road-load dynamometer control to simplify fuel antidetonation-quality evaluation by simulated road testing and an announcement of a detergent additive for light-aircraft oil warranted not to leave the deposits known to lead to preignition and increased antidetonation requirements.

Three other aspects of the overall problem of making the best use of available petroleum resources were explored. A summary of the U. S. Navy's continuing investigation of ignition-quality-improving additives for diesel fuels disclosed that certain peroxides and nitrates increase cetane number 20 or more units, but the ideal additive is yet to be found. A CRC committee reported that tendency toward vapor lock in fuel systems of personal aircraft can practically be abolished if the committee's design recommendations are followed. Two lubri-

Outstanding example of the hot rods discussed at the dinner arrives at the Mayo Hotel driven by Jim Dahm, who together with his brother Tom built it. On hand to welcome are dinner speakers Don Francisco (left) and Wally Parks of "Hot Rod Magazine," D. R. Frey, John Baird, and handshaker H. P. Enders. Dahm drove his SCTA Class B Modified Roadster all the way from Pasadena even though it has only 2-in. road clearance. It's the car that set a new class record in this year's Bonneville National Speed Trials

Economics of LPG, at Tulsa Meeting

cants researchers praised the 4-cyl, L-head International Harvester engine used in the IH Farmall Cub tractor as a useful small-scale laboratory-test engine for studying both motor oils and fuels.

The comprehensive report on liquefied petroleum gas—which is primarily the high-octane hydrocarbons propane and butane—showed that there is no fundamental technical stumbling block to its use as an automotive fuel. While opinion was sharply divided as to whether or not LPG operation is cheaper in the final analysis than gasoline or diesel, certain cost trends were generally conceded: LPG installations—including engine, storage, and dispensing and ventilating equipment—cost considerably more than gasoline facilities. Use of LPG cuts maintenance costs. Delivered price of LPG from Southwest oil wells varies with locality. In the East, refinery propane usually costs less than oil-well LPG, but supply of the lower-cost material is limited.

It was clear that availability of LPG and the price differential between LPG and competing fuels will be important factors in determining popularity of LPG engines for buses, tractors, and stationary installations. Spokesmen for manufacturers assured prospective users that specially designed engines and good conversion kits are all ready for any of these applications.

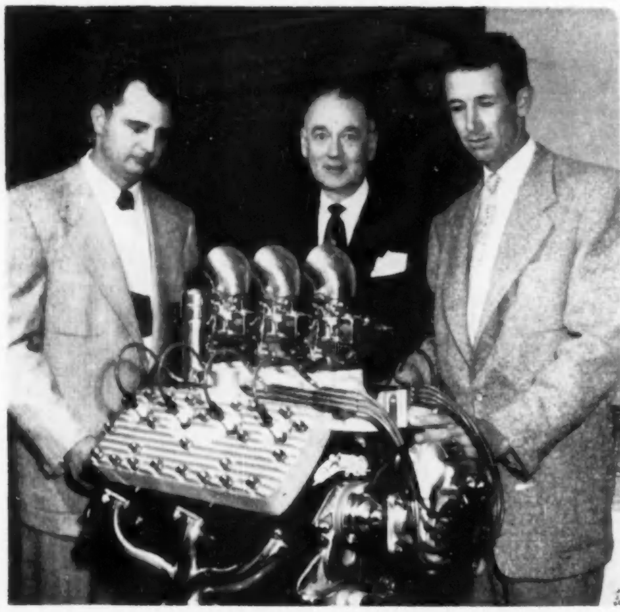
For the benefit of those uninitiated in detonation investigation—if there were any among the 467 registrants—even the fundamentals of the problem were outlined by various speakers and discussers. Detonation, or knock, was defined as "abnormal combustion which proceeds initially in a normal manner, but after some part of the fuel is burned, the pressure and temperature of the remaining unburned charge exceed critical values which the fuel cannot withstand. At this point, all of the remaining fuel burns at once, or detonates, instead of burning by the normal flame progression. This sudden burning sets up a pressure wave which, although not much higher in absolute pressure than for normal combustion, has a much higher velocity than normal."

Detonation is undesirable because a considerable part of the energy thus released is not transformed into crankshaft power but is lost as waste heat, engineers were reminded. Worse than the energy loss, the high-velocity gases impinging on the aluminum parts of aircraft engines gradually remove particles of the metal—a process one speaker called "sandblasting with gas."

Therefore detonation imposes limits on the power output of otto-cycle engines.

Antiknock rating of a commercial fuel, it was recalled, is based on the matching of knock intensity of the commercial fuel with that of blends of isooctane (equals 100 octane) and normal heptane (equals 0 octane) in a standardized engine under standardized conditions. Octane rating of the fuel tested corresponds to percentage of octane in the matching reference blend. Two laboratory rating

John Moxey Jr., Meetings Chairman, and Art Willey, Vice-President for the F & L Activity, indulge in earnest conversation with W. J. Randall, Section Chairman of the host Mid-Continent Section



Dinner speakers Don Francisco (left) and Wally Parks (right) make a quick check of their hot-rod engine exhibit before joining W. J. Carthaus (center), toastmaster, at the speakers' table.

Dinner session featuring hot rods gave professional engineers a chance to learn how the amateurs operate. Technical Editor Don Francisco and Editor Wally Parks of "Hot Rod Magazine" presented a technicolor movie and a talk on "The Development of the Hot Rods" for the enjoyment of an audience of 200. Also on hand were Jimmy Dahm and his record-breaking hot rod.

In commenting on their movie showing hot-rod designs and race meets, Francisco explained that 98% of hot-rod engines are second-hand Ford V-8's souped up to the limit. Some of these engines deliver as much as 240 hp for 296 cu in. displacement. They run on 91 to 100 octane-rating fuels, sometimes containing up to 10% nitromethanol. Castor oil is often the engine lubricant.

First thing a hot-rodder does with a newly acquired engine is tear down and inspect for cracks with x-ray and magnaflux. If there are no cracks, he enlarges the valve ports with his hand grinder, adds special cylinder heads to give compression ratios as high as 11:1 or even 13:1, increases bore and stroke, and installs special pistons, crankshaft-balancing devices, and extra carburetors. Bodies, too, are modified to increase speed and suit the owner's taste in racing styles.

Object of all this exercise in ingenuity is competition in time trials, held preferably on dry lakes, continued Parks in his talk following the movie. Hot-rod organizations like the Southern California Timing Association do everything to make these trials safe for participants and spectators. They emphasize full compliance with traffic regulations before and after meets, adequate equipment, and safely conducted races. Timing associations prohibit their members from participating in street racing. They try to discourage that dangerous practice by providing events in which all hot-rod enthusiasts can compete.

So conscientious have organized hot-rodders shown themselves, that California police departments and businessmen are now sponsoring hot-rod activities, according to Parks. "There need not be a hot-rod 'problem' in any state wherein the people are open-minded enough to realize that here is a natural expression of that valuable American heritage—American ingenuity," he said in closing.

methods, involving different sets of operating conditions, were distinguished, the less severe test being the Research Method and the other set the Motor Method.

Just as fuel antiknock quality as expressed in terms of octane numbers varies among fuels, so does octane number requirement vary among engine designs, among engines of the same design, and even in a particular engine under various operating conditions, it was recalled.

To study octane-number requirements of stock engines, fuels must be observed in the engines, preferably under road conditions; but reproducibility and repeatability is poor with road tests because of the lack of control of many of the variables. This explanation prefaced the announcement of an electronic dynamometer control which automatically imposes on a laboratory-mounted engine the same loads that the engine would encounter if it were installed in a car operating on the road. Developers of the control are a group of fuel testers and electronic engineers at the Shell Development Co. They explained that their electronic road load (ERL) control applies a road load corresponding to a given throttle setting or change in throttle setting. Usefulness of the control is not limited to fuel rating, they pointed out. Coupled with an automatic throttle control, it could provide any cycle of operation for studies of engine deposits and wear.

An authority on fuel rating by means of the chassis dynamometer remarked during the discussion that for agreement of his laboratory data with road-test data, laboratory-engine oil, water, carburetor-air, and induction-system temperatures must show reasonable agreement with those on the road. He felt certain that these temperature variables would be important also in obtaining agreement between results of ERL-controlled engine-dynamometer-tests and road tests.

Actual road tests of octane-number requirements made as part of CRC's 1949 survey were reported to

ndicate that just about half the cars then in operation knocked on the fuel found in the tanks—and owners were aware of it. Of the 306 cars tested, 63 knocked more at part-throttle than with the throttle wide open. Several had maximum part-throttle requirements 5 to 6 octane numbers higher than their maximum full-throttle requirement. One difference of 12 octane numbers appeared. In approximately 80% of the cars, the maximum requirement occurred below 1400 rpm.

Graphs were presented which showed that 84-Research-octane (typical current "regular") fuel would satisfy maximum octane-number requirements of about 55% of the cars; and 91-octane (typical current "premium") would satisfy just over 90%.

The CRC survey also covered engines furnished by their manufacturers and considered to be in good condition. Individual clean engines showed variations of as much as 6 octane numbers when distributor spark advance was varied within the manufacturer's tolerance. Accumulation of deposits increased requirement considerably. Various engines of the same make and with the same spark advance and deposit condition showed different requirement levels.

Marked variation in requirement was reported also by an engineer investigating light-aircraft engines. He found that lean mixture, low carburetor-air and cooling-air temperature, high spark advance, and reduced cooling airflow increased the take-off octane requirement substantially—from 81 to 97, or 16 octane numbers, in one case. Fuel-air ratio variations accounted for 4–6 units and affected fuel consumption about 50%. Either abnormally low or abnormally high carburetor-air and cooling-air temperatures had deleterious effects on requirement, he added, the optimum temperature being 100 F.

Fuels presently available for personal aircraft were declared to be adequate for all normal operation, now that refiners are controlling fuels to 80 octane for lean cruise and 87 for rich take-off conditions.

Results of an investigation into effects of detonation contradicted published reports that even moderate detonation under take-off conditions will cause the engine to disintegrate or deteriorate rapidly. However, long-term operation under medium or heavy detonation will erode aluminum parts and wear rings sufficiently to require earlier overhaul, it was conceded.

Sudden piston failures were laid to preignition—which was defined as abnormal combustion initiated from a hot surface rather than by the spark. Early firing from preignition develops higher combustion-chamber temperatures and pressures, causing subsequent cycles to fire still earlier. Temperatures high enough to melt pistons are developed in a few minutes.

It was found that common detergent oils leave deposits having very high melting or vaporizing temperatures which prevent their elimination from the combustion chamber. These deposits support preignition in aircraft engines.

For these reasons, California Research Corp. has developed new additive materials which a spokesman claimed will provide cleaner engines than the highest-level-detergent compound now generally used but which will not form combustion-chamber deposits capable of supporting preignition. The new class of compounds is performing well in airline and military engines and is undergoing flight tests in smaller aircraft. Not only is preignition avoided, but the lack of deposits diminishes or eliminates the gradual increase in octane-number requirement accompanying buildup of engine deposits.

Creditlines for SAE's Largest Tulsa Meeting

Host to the 467 who registered at the 1950 SAE National Fuels and Lubricants Meeting was SAE Mid-Continent Section led by Section Chairman W. K. Randall. Section Vice-Chairman D. R. Frey and John Baird played right-hand men to W. J. Carthaus, General Chairman of the meeting and toastmaster at the dinner. H. P. Enders served as Treasurer of the meeting and Chairman of the Entertainment Committee. He also starred on the team that boosted dinner-ticket sales to 200.

J. V. Brazier, Chairman of Housing and Reception, saw to it that all comers had comfortable accommodations. And everyone in Tulsa was ready to welcome the SAE visitors as a result of Don Frison's inducing local newspapers to publish seven features on the two-day affair plus at least three shorter announcements.

The friendly, informal atmosphere created by Oklahoma's very special hospitality, encouraged profuse and spirited discussion of the nine papers presented. These represented the efforts of 17 authors and hundreds of their coworkers — plus expenditure of tens of thousands of dollars on the five research projects reported.

The lively technical program that packed from 150 to 300 into each session resulted from year-long efforts of F & L Meetings Chairman John Moxey Jr. and his committeemen, aided at one time or another by almost everyone on the F & L Activity Committee.

Sale of over 1000 preprints at the meeting testified to the quality of the papers they secured. As usual, SAE Journal will publish digests of all the papers, and those papers approved by Readers Committees will be published in full in SAE Quarterly Transactions.

Under the general chairmanship of **W. J. Carthaus**, the following served as chairmen of four technical sessions of the SAE National Fuels & Lubricants Meeting: **L. A. McReynolds, A. B. Boehm, J. J. Mikita**, and **Herb Rawdon.**

This report is based on discussions and nine papers . . . "Performance and Stability of Some Diesel Fuel Ignition and Quality Improvers," by **W. E. Robbins, R. R. Audette**, and **N. E. Reynolds, III**, U. S. Naval Engineering Experiment Station; "Liquefied Petroleum Gas As A Fuel For Automotive Vehicles," **Leonard Raymond**, Socony-Vacuum Oil Co.; "Small Engines and Dynamometers for Pilot Testing," by **W. F. Ford** and **O. L. Spilman**, Continental Oil Co.; "An Engine Dynamometer Control For Fuel Evaluation by Simulated Road Tests," by **A. R. Isitt, M. R. Wall**, and **A. G. Cattaneo**, Shell Development Co.; "Antiknock Requirement of Passenger Cars (1949 CRC Octane Number Requirement Survey)," by **H. W. Best**, Yale University, **J. E. Taylor**, Gulf Oil Corp., and **H. J. Gibson**, Ethyl Corp.; "The Potentialities of Fuel Antiknock Quality, by **H. E. Hesselberg** and **W. G. Lovell**, Ethyl Corp.; "Fuel and Lubricant Requirements of Personal Type Aircraft Engines," by **W. V. Hanley**, Standard Oil Co. of California; "Recommendations for Fuel System Design for Personal Aircraft with Regard to Vapor Lock (Report of CFR—AFD of CRC)," by **L. L. York**, Continental Motors Corp., **A. Hundere**, California Research Corp. and **R. A. Coit**, Shell Development Co.; and "Light Aircraft Engine Tests—Fuel and Operating Variables," by **V. E. Yust**, Shell Oil Co.

All of these papers will appear in abridged or digest form in forthcoming issues of SAE Journal and those approved by Readers Committees will be printed in full in SAE Quarterly Transactions.

Two recently discerned quantitative relationships between engine design factors and antiknock requirements were expounded at the meeting. To simplify their presentation, the performance-number scale was introduced: PN equals 2800/(128—octane number) below 100 octane, and PN is a function of performance with isooctane plus TEL above 100 octane. The concepts are:

1. Gains in knock-limited power output possible with design for higher manifold pressure (achieved by supercharging, for example) are directly proportional to the percentage change in performance-number requirement.

2. Gains in knock-limited compression ratio (made possible by increases in fuel antiknock level) are proportional to the percentage increase in performance-number requirement.

Interest in higher-octane fuels for spark-ignited engines was matched by interest in higher-cetane-number diesel fuels. The U. S. Navy is interested in ignition-quality improvers for (1) addition to fuels for arctic service, where requirements for low pour point conflict with requirements for ignition quality of 50 cetane number or higher, and (2) use in possible future engines offering better power or economy in return for higher cetane requirement, three researchers explained. Among additives tested, a nitro alkane, various amyl nitrates, a nitro carbamate, and a peroxidized petroleum distillate were promising. In concentrations of 1.5% these additives increase cetane number by 20 or more units.

They do improve startability and slightly reduce smoke. They need not materially increase deposits on engine parts outside the piston-ring belt. On the other hand, they lose effectiveness under certain storage conditions, tend to cause ring sticking, and reduce power output somewhat, it was noted.

Dinitropropane and normal primary amyl nitrate both had boosters among discussers. One, who had had experience with dinitropropane, described a phenomenon he hasn't been able to rationalize: "Cetane number as obtained by additives is of little value for improving starting at low ambient temperatures in laboratory engine tests. However, as determined by critical-compression-ratio tests in the laboratory and by the field tests where normal engine wear causes loss of compression, additive cetane numbers are as good as natural cetane numbers insofar as starting is concerned."

Some current designs of personal planes definitely have inadequate margins of safety with regard to vapor lock, a report of the Aviation Fuels Division of CRC's Coordinating Fuels and Equipment Research Committee revealed. To improve the situation, the committee has drawn up a list of recommendations, which they included in their report. Object of the recommendations is to keep the fuel in all parts of the fuel system at minimum temperature and maximum pressure. The committee also outlined in the report a flight-test procedure for insuring vapor lock protection in new and revised designs.

Continental Oil Co. researchers who are using the 4-cyl, L-head engine standard in International Harvester's Cub tractor for pilot testing revealed the reasons for their choice: The rugged little Cub engine resembles automotive engines in design, even to the hardened crankshaft which makes possible use of copper-lead connecting-rod bearings. First cost is reasonable, and replacement parts are readily attainable. Only modifications made to the engine are plugging the oil passages to the cam followers and substituting corrugated oil pans for flat ones. (The corrugations cut down capacity. Besides, their increased surface area allows addition of more heat to maintain high oil-temperature conditions without raising local pan temperatures to the point where oil deposits would form.)

Four 40-hr test schedules have been devised, their respective purposes being to (1) determine base-oil deposit-forming characteristics and optimum degree of solvent treating, (2) show detergency requirements for base oils and indicate L-4 bearing losses, (3) produce bearing loss data corresponding closely to L-4 data, and (4) simulate the FL-2 on only 50 gal of fuel.

Numerous discussers hailed the Cub production engine as an economical evaluation tool. But one countered that manufacturing tolerances of production engines and their replacement parts are so great that test reproducibility might be seriously affected—just the kind of healthy difference of opinion that pervaded the whole meeting.

Correction

An error was made in Table 1, p. 62, of the article "Five Diesel Valve Troubles," in the September, 1950, SAE Journal. "Scaling Resistance" should be in "mg per 200 hr," not "200 mg per hr."

TECHNICAL COMMITTEE *Progress*

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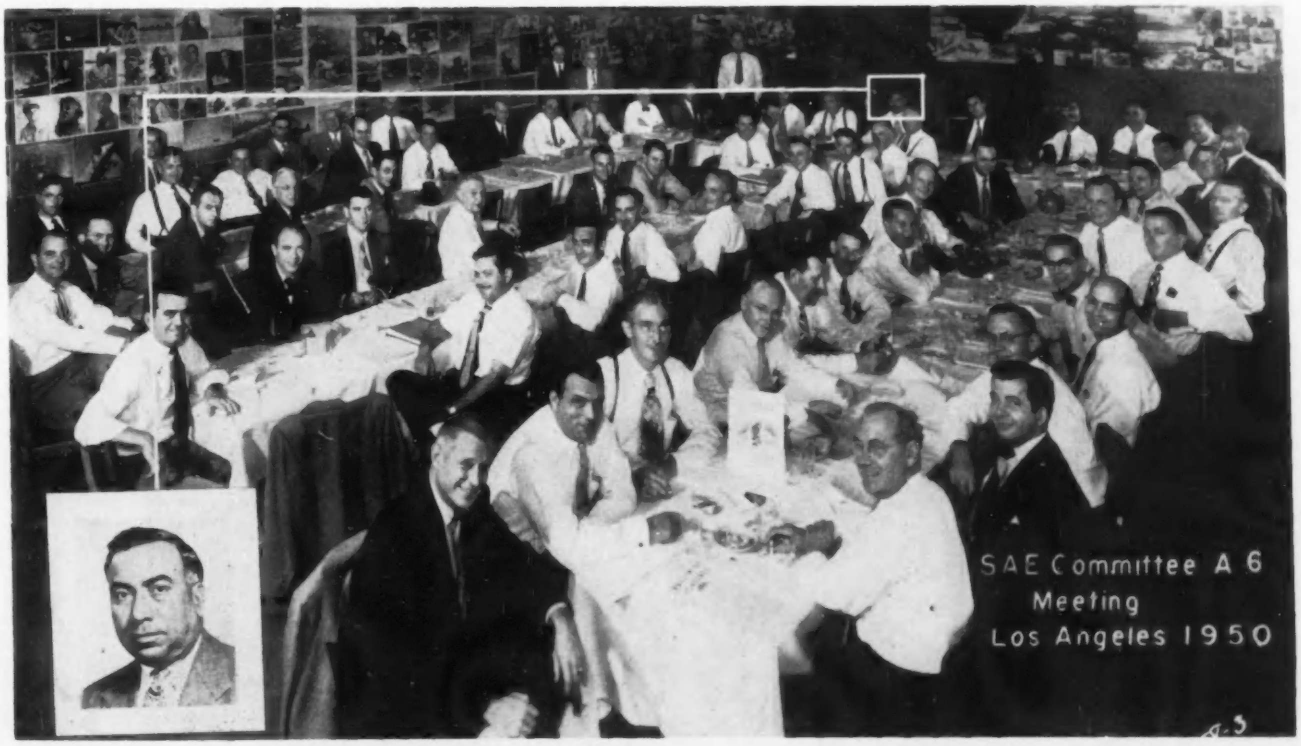
Aircraft Hydraulics Men Score Advances in Equipment Standards

BIG strides toward improving efficiency and life of aircraft hydraulic systems as well as anticipation of coming pneumatic system requirements marked achievements at a recent meeting of three committees of the SAE Aeronautics Committee. The five-day session in Los Angeles brought together more than 150 members and guests of Committee A-1, Aircraft Pumps, Committee A-3, Aircraft Valves, Fittings and Flexible Hose Assemblies, and A-6, Aircraft Hydraulic and Pneumatic Equipment Committee.

Engineers from both industry and the military services exchanged ideas and experiences aimed at bringing up-to-date military standards and specifications on hydraulic equipment. Men from industry pointed up ways in which military specifications could better reflect current industry practices and developments and operational conditions of equipment in the field.

On hydraulic equipment safety and longevity, meeting discussions brought to light up-to-date experience with nonflammable hydraulic fluids, storage problems with hydraulic units, and fire tests for hose. Efforts toward space and weight conservation were exemplified by new specifications under way for cylindrical accumulators, steel tub-



Chairman B. R. Teree (inset), New York Air Brake Co., presiding at the recent meeting of SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment

ing, cluster fittings, and high-speed pumps. Revisions in hydraulic brake specifications and hydraulic pump cold-starting requirements were proposed to meet current operational requirements.

Nonflammable Fluid Problems

Field reports on the several type nonflammable hydraulic fluids—such as the Navy hydrolube fluids and Skydrol—pointed up shortcomings in most of them still to be overcome. Some of these fluids swell packing materials; others are somewhat corrosive; and still others separate into layers, one of which solidifies at low temperatures. Inconsistency from batch to batch of fluid too seems to plague the industry in general and packing material manufacurers in particular.

F. O. Hosterman, Lockheed Aircraft Corp., reported that his company was troubled with O-ring swell and accumulator and filter difficulties with one type fluid. Several Navy aircraft were said to be experiencing similar difficulties. D. E. Leach, Chance Vought Aircraft, said packing swell tests had been made with one fluid on packing from 12 different manufacturers and only one type packing remained within military specification limits. Leather backup rings swelled to twice their original size and squeezed down the O-ring, but apparently caused no operational problems. However, reassembling the swelled units was a tough job.

Corrosion from one fluid was found confined to the brake system. It was felt that this stemmed from contamination of the fluid with some material extracted from the expander tube. Only aluminum alloy parts were corroded, and some of these failed in less than 50 hr of operation, or about three months of actual time.

Another report on one of the fluid types had it that this fluid separates into three layers, one of which freezes solid at -40 F. Heating the fluid to 170 F separates it into two layers when lowered to room temperature.

Packing manufacturers find that any one fluid type varies from batch to batch. They feel this must be rectified before they can develop suitable compounds for hydraulic systems.. Another problem is in handling packings. It is easy to mistake packings for use with one type fluid with packings for another, or with packings for high-temperature use, observed F. W. Murphy, Douglas Aircraft Corp. He urged that something be done about this too.

E. M. Polk, Air Material Command, said that test work was continuing at the AMC on experimental silicone-base fluids. Trouble with this fluid is that it can get along only with natural rubber packing material. Emergency conditions could make natural rubber a suddenly scarce commodity, as in the last war. Job is to make this silicone fluid more compatible with more readily available packing materials, or to find other packing materials that will do the trick.

Discussions on hydraulic equipment safety and life brought out disagreement over storage limitations on hydraulic units specified by the military services. Present specifications require removal and replacement of all seals and packings if a unit has not been placed into service within one year. Hosterman advised that this entails much work by the aircraft manufacturer to keep track of the tim on each unit and to replace old pack ings. Hydraulic equipment specialist agreed that such practice is not neces sary, that packings in storage for mor than one year should function prop erly in service. Meeting participant voted to ask the services to remove thi requirement in the next revision o hydraulic equipment specifications.

Committee A-3's search for reproducible fire tests for hydraulic hose was enlarged on by R. W. Phillips, Weatherhead Co. A group under him found that drawback to fire test reproducibility is lack of burner equipment that yields consistent heat conditions. There are indications that gaseous fuel is necessary to get desired results. Liquified petroleum gas has been recommended because of the greater uniformity obtainable.

From Spheres to Clyinders

Space and weight saving aspects of hydraulic equipment discussions foused first on the advent of cylindrical accumulators as a replacement for the spherical type. Advantage of the diaphragm of the sphere, is that it makes better use of space for the same cubic displacement.

Committee A-6's part in this changeover is the development of envelope dimensions so that cylindrical accumulators can be interchangeable. Such a proposal now under way also will include number and location of mounting places.

Resistance of the cylindrical accumulator to gunfire, especially in the light of new ammunition types, was given prominence at the meeting. It should not become a fragmentation bomb when hit by gunfire. Size of exit hole

SAE Committee A-1, Aircraft Pumps, takes time out from its full agenda. J. M. Kidd (inset), Glenn L. Martin Co., is chairman of the group

om a gunfire hit that the accumulator would tolerate, as formerly specified, no longer seems to be an important consideration.

Weight-saving considerations favor the switch from aluminum to stainless steel tubing for high pressure systems, according to meeting discussions. In any given tube size, wall thickness of the stainless steel tubing is considerably less than that of the aluminum one. The weight saving is about 15%, based on carrying capacity, for stainless steel tubing with Ermeto fittings, noted H. E. Cornish, Douglas Aircraft Corp.

Cornish said that Douglas conducted comparative tests on 61ST aluminum and stainless steel tubing in six sizes, ranging from 3/16 to 5/8 in. The tests consisted of cycling from 0 to 4500, psi. Average number of cycles completed before failure was 140,000 for both aluminum and steel tubing. Cornish pointed out that rate of cycling affects fatigue life and must be considered in any future evaluation program.

Another development in hydraulics equipment that promotes economy at both the manufacturing and service levels is cluster fittings, described by J. C. Bloom, Douglas Aircraft Corp. The cluster fitting, shown in Fig. 1, consists of standard bodies and stems which can be assembled in any arrangement to satisfy a given piping need. Practice has been to use manifold blocks, also shown in Fig. 1, which are special parts and must be carried as spares, with little chance of re-use on other airplanes. Once established for a certain application, the block cannot be altered for any modification change.

Clustering several bodies on a stem reduces the number of packing and tubing connections, and therefore the number of potential leakage sources. It is lighter and more compact than a manifold block arrangement. Assembly of these clusters is simple and positive.

Committee A-3 is conducting an industry survey, reported Chairman L. J. Henderson, Weatherhead Co., to see if there is a need for such fittings.

Space saving as well as higher pressures are the motives behind higher speed hydraulic pumps. These new pumps are designed for rpm's in the order of 8250, as compared with 3750 rpm of older types. Committee A-1 is preparing specification requirements for such high-speed hydraulic pumps and R. G. Horton, Hamilton Standard Division, United Aircraft Corp., heads up this project.

The Aircraft Pumps Committee also came up with more realistic recommendations for cold starts in AN specifications for both constant displacement and variable displacement pumps, reported Chairman J. M. Kidd, Glenn L. Martin Co. It was recommended that requirements be raised from 750 to 3750 rpm, but that the present time limit of 10 sec be changed. According to the recommendation made by C. L. Sadler, Sundstrand Machine Tool Co., the pump should be brought up to final speed in three stages, allowing a dwell period between each and taking a total of some 50 sec. This was said to be more in keeping with current jet engine starting characteristics.

Another operational problem that drew attention in Committee A-6 is brake dragging in airplanes with power brakes. Back pressure from the reservoir prevents complete brake release, explained R. C. Bumb, North American Aviation, Inc. He urged establishing a specific requirement for a minimum pressure at which brakes will not drag.

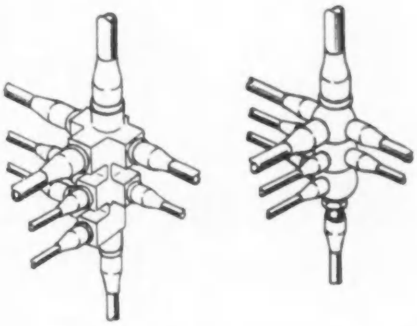


Fig. 1—Universal cluster fittings to couple tubes are said to have advantages over the inflexible machined manifold block arrangement at left. The manifold block installation has 10 leakage points and consists of 21 parts; the cluster fitting counterpart has only six leakage points and but 11 parts.

C. E. Deardorff, Bendix Aviation Corp., Pacific Division, was made chairman of a subcommittee assigned to develop suggested revisions in Specifications MIL-W-5013, MIL-V-5525, and AN-B-2.

Committee members left current problems with hydraulic systems and looked ahead to what pneumatics might bring in the future. The Air Force finds pneumatic systems attractive, discussion brought out, because they are lighter than hydraulic sys-

Guests from industry and the military services joined SAE Committee A-3, Aircraft Valves, Fittings, and Flexible Assemblies, to thrash out common problems. All took away new food for thought, reported Chairman L. J. Henderson (inset), The Weatherhead Co.

tems. It is presently testing two fully pneumatic-equipped airplanes—one a B-26, the other is of more advanced design.

To ease the transition to pneumatic systems, if and when it comes, Committee A-6 is preparing specification requirements on design, installation, and testing of aircraft pneumatic systems. Plan is to propose this as an MIL specification, said chairman B. R. Teree, New York Air Brake Co., to be submitted to the Aircraft Industries Association, for transmittal to the joint Air Force-Navy Aeronautical Standards Group for final approval. The proposal will be patterned after current hydraulic system specifications.

SAE Lighting Standards Near For Transport Plane Cockpits

FIRST step toward a standardized cockpit layout for transport aircraft is close to realization. A proposal covering a uniform practice for instrument and cockpit lighting, which is to form the basis of an SAE recommended practice, has been completed by SAE Committee S-7, Cockpit Standardization.

The new proposal aims to provide lighting of proper intensity and distribution under all external lighting conditions. With such a lighting system, crew members should be able to read instruments, placards, check lists, manuals, maps, and so forth without undue interference with their vision outside of the aircraft.

The proposed document establishes for the first time a realistic guide for red and white cockpit lighting instead of the cut-and-try methods to date. Lighting values indicated are physiologically correct for the transport pilot, according to Capt. Scott Flower, Pan American World Airways, who heads up the project.

Results from Air Force and Navy researches on aircraft crew lighting needs have been translated into practical specification requirements. In fact, says Flower, the lighting values proposed more than satisfy minimum requirements.

It is hoped that the recommended

BEARD

FLOWER

practice growing out of this proposal will serve to guide lighting installations in future commercial aircraft designs. Periodic review of the document is planned to keep it in step with latest aircraft lighting developments.

Industry's efforts to standardize cockpits go back to 1943. At that time the National Aircraft Standards Committee of the Aircraft Industries Association set up such a project. The military services too have pursued cockpit standardization since the war under the Munitions Board. First product of this work was the Air Force-Navy Aeronautical Bulletin No. 386, Recommended Guide for Location and Actuation of Pilots' Controls. This bulletin generally applies to single-pilot military aircraft.

Mindful of the difficulties facing a pilot in switching from one airplane to another, the Civil Aeronautics Board also has long felt the need for some cockpit layout uniformity. It has issued a proposal on cockpit layout and control knob shape for commercial aircraft.

Formation of the SAE Committee last year grew out of a request from the Air Transport Association. The ATA felt that a group under the SAE Aeronautics Committee could develop recommended practices on cockpit standardization reflecting practical day-to-day requirements as well as projected needs. Participating in the group are engineers from leading aircraft manufacturers, airlines, and Government agencies, under the chairmanship of M. G. Beard, American Airlines, Inc.

In addition to the proposed recommended practice on lighting, the group has gone a long way toward completing a similar specification on aircraft controls. R. L. Thoren, Lockheed Aircraft Corp., heads up this project. New jobs recently undertaken by the Committee are one on visibility, another on warning and emergency lights, and a third on jet aircraft controls.

Thank You, Mr. Schenck

R. B. Schenck, for many years chief metallurgist of Buick Motor Division, GMC, has resigned his membership, for reasons of health, from five divisions of the SAE Iron & Steel Technical Committee, although he will continue to serve on Panel C, Automotive. On behalf of the Committee membership, Chairman M. L. Frey, extended Schenck a vote of gratitude for his active participation and leadership in the Committee's work. One of Schenck's big contributions to SAE technical activity was his generalship of the Committee's investigation of boron-treated steels, which was productive of two reports. This work takes on growing importance since present emergency shortages may bring wider use of boron steels.

Plan Standard Connector For Tractors, Implements

FARM tractor and electrical equipment engineers are well along toward establishing requirements for a standard connector between tractors and towed implements.

At a recent meeting of the Tractor Lighting Subcommittee, jointly sponsored by the SAE Tractor Technical Committee and the Farm Equipment Institute, desired features of such a connector were aired. Discussion favored a three-point connector (one point grounded), even though only two wires are needed. It was pointed out that some states may require a stop light or outline lights to indicate overall width. In this case, the third connector point will be needed.

Also suggested was that connector

Continued on Page 106

Why Diesel Powered Trucks Are Outnumbered

Based on paper by

L. L. BOWER

Waukesha Motor Co.

ALTHOUGH popularity and use of diesel-powered trucks is increasing, there is an overwhelming demand for the gasoline-engined truck. Here are some of the reasons for this marked preference:

The smaller trucks are produced mainly by passenger car companies, using standard or modified car engines or a new larger truck engine. Large volume brings lower cost.

Of the trucks in operation, 28% are over 10 years old. Few diesels were made 10 years ago.

Type of service: light, city delivery, start and stop, and lots of idling.

Easy starting in coldest weather.

Power output per cu in. at maximum speed is greater.

Weight per cu in. is less and there is a still greater saving on a horsepower basis, which is further improved by the lower weight starting system, including battery.

Less noise when idle and when loaded.

Odor of exhaust is not objectionable.

Smoke is no problem compared with some diesels with poorly adjusted injection pumps, or pumps set rich.

Less frequent oil and oil filter change periods.

Less use of lubricating oil.

Higher engine speeds generally allowed.

Lower repair parts cost.

Lower engine cost. In the 100-125 hp class (300-320 cu in. displacement) a gasoline engine lists at about $575 bare, and about $710 with all accessories less battery. The same size diesel would list at $1250 bare, $1420 with all accessories. In the 200-240 hp class (775 cu in. displacement) the gasoline engine lists $1850 bare, $2200 with accessories; the diesel, $3110 bare, $3480 with accessories. To offset the higher initial engine cost through fuel saving, the diesel would have to travel between 50,000 and 60,000 miles.

(Paper "Basic Reasons for Preponderance of Gasoline Powered Trucks," was presented at SAE National West Coast Meeting, Los Angeles, August 14-16, 1950. It is available in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to non-members.)

Tire Separations Detected By Supersonic Test Machine

Based on paper by

G. M. SPROWLS

The Goodyear Tire & Rubber Co.

TO recap or not to recap a tire need no longer be a by-guess-and-by-gosh decision. Thanks to a recent device—the supersonic separation tester—it is possible to find any separation in a tire, if it's there, rather than to hazard the not-always-infallible judgment of man.

Here is how the supersonic separation tester, shown in Fig. 1, works:

The tire is placed in the machine and rests in a liquid solution. In this solution is a crystal transducer or vibrator producing a supersonic sound. This sound passes through the tire directly above the transducer and is picked up by a microphone opposite the transducer and inside the tire. Intensity of the sound wave reaching the microphone is registered on a meter shown in front of the equipment.

When the carcass is sound and no separation is present, the meter reads full scale and a green light shows. A separation between the transducer and microphone reflects back a sound wave of decreased intensity to the microphone.

Fig. 2 is a close-up of the transducer, which is underneath the two rollers. The microphone, directly above it, is adjustable and can rest against the tire after it has been mounted in the machine. (Paper "Tires and Tubes for Commercial Vehicles and Factors Affecting Their Service," was presented at SAE Summer Meeting, French Lick, Ind., June 8, 1950. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

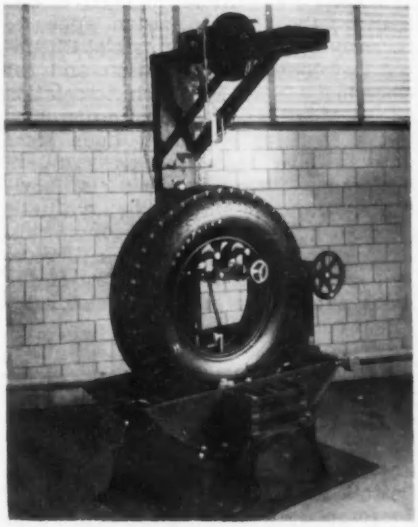


Fig. 1—The supersonic separation tester shows up tires unsuitable for recapping by detecting any separation in tire carcass

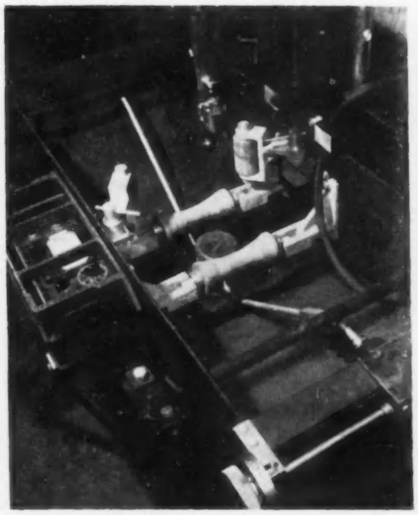


Fig. 2—The transducer, below the rollers, sets up supersonic vibrations in a liquid, which pass through the tire and are picked up by a microphone

SAE Cosponsors An Air Cargo Day

SAE again cosponsored Air Cargo Day, November 28, a two-session segment of the ASME Annual Meeting at the Hotel Statler in New York. The afternoon session considered cargo handling equipment; the evening session considered military cargo transport. Papers and discussions were supplemented with an exhibit showing latest air cargo developments. Robert B. Lea, of the Sperry Corp., was chairman of this joint ASME-IAS-SAE affair. SAE members active in arranging the meeting included George Hayes of American Airlines, Charles Froesch of Eastern Airlines, and L. R. Hackney of Lockheed Aircraft.

About

COLBERT

KELLER

K. T. KELLER has been elected chairman of the board and **LESTER L. COLBERT**, president of Chrysler Corp. Keller has been president since 1935 and Colbert has been president of Chrysler's Dodge Division and a director of the Corporation since December, 1945.

Keller, who will continue to exercise general oversight over the corporation's business affairs, is also serving in a part-time capacity as special advisor to Secretary of Defense George C. Marshall on military research, development, and production of guided missles. This new post was created to dovetail the separate programs of the various services to prevent waste and duplication. Colbert has been associated with Chrysler Corp. since 1933, and during World War II had charge of the Dodge Chicago plant where Wright aircraft engines were manufactured. He was graduated from University of Texas in 1925 and from Harvard Law School in 1929.

ROBERT F. THOMSON, formerly a metallurgist with International Nickel Co., Detroit, Mich., is now employed by GMC in the Research Laboratory as assistant head of the metallurgical research department.

ROBERT M. BRAM is now employed with the Grumman Aircraft Corp., Bethpage, N. Y. as an aeronautical design engineer. He was formerly with the Chance Vaught Aircraft Co., Dallas, Texas.

HARMON S. EBERHARD is now executive vice-president with the Caterpillar Tractor Co., Peoria, Ill. Eberhard, who has been a vice-president since 1942, will share the increasing responsibilities of top administration and will continue to give administrative direction to the research and engineering departments.

E. W. JACKSON has been promoted to vice-president of the Caterpillar Tractor Co., Peoria, Ill. Jackson, who has been director of parts and service since 1947 will continue administrative direction of those departments as a vice-president.

JOSEPH GESCHELIN, past SAE vice-president, Detroit editor, Automotive Industries, addressed a meeting of Naval Reserve officers at the Philadelphia Navy Yard on November 1. Subject of the lecture was a discussion of supply problems in a state of emergency and the problems of machine tool requirements.

JAMES D. THACKREY, formerly a research engineer with the Jet Propulsion Laboratory, California Institute of Technology, is now employed by the Aerojet Engineering Corp., Azusa, Calif., in the capacity of development engineer in the rocket physics department.

E. S. STARKMAN left Shell Development Co., Emeryville, Calif., on September 15, and has accepted an assistant professorship in mechanical engineering at the University of California, Berkeley, Calif.

C. L. McCUEN, General Motors vice-president and general manager of Research Laboratories Division, appeared recently before the Commercial Chemical Development Association and the Chemical Market Research Association at the Mayflower Hotel. He discussed many features engineers hope some day to give motorists as standard equipment, listing better fuels, lubricants, transmission fluids, synthetic rubber, adhesives, plastic materials, plating processes, finishes, antifreezes and metal alloys as only a few of the items automotive men hope chemistry will produce.

BENSON FORD, vice-president of Ford Motor Co. and general manager of the Lincoln-Mercury Division, was guest of honor at a special dinner on Nov. 13. The event, sponsored by the Detroit Round Table of the National Conference of Christians and Jews, was held at the Masonic Temple in Detroit. The occasion marked the 22nd anniversary of the founding of the Na-

About SAE Members

tional Conference of Christians and Jews and was the second meeting of its kind to be held in Detroit.

P. L. WARD has transferred from the position of Washington representative for Solar Aircraft Co. to that of assistant chief engineer, Development Engineering, San Diego plant.

JESSE E. WHITE, JR., formerly with Mack Trucks, Inc., New York, is now with Cummins Diesel Sales & Service of New York, Inc.

The appointment of **THOMAS F. BERGMANN** as manager of the Sales Engineering Division and **GORDON V. CHRISTY** as west coast sales engineer of the Wright Aeronautical Corp. was announced by **E. C. SULZMAN**, Wright sales manager. In the new assignments, Christy will replace Bergmann as the aircraft engine company's representative in Los Angeles, where Bergmann has been stationed since June, 1947. Bergmann will direct an expanded Sales Engineering Division. Both men have been with Wright Aeronautical since before World War II.

VOLLMER W. FRIES, vice-president in charge of manufacturing of the White Motor Co., Cleveland, has been elected a term trustee of Rensselaer Polytechnic Institute, Troy, N. Y. He was graduated from there as an electrical engineer in 1924. As a trustee of RPI, he will serve the nation's oldest school of science and engineering and the largest in day enrollment among privately endowed engineering colleges. Fries is also a trustee of Fenn College in Cleveland.

H. A. ENGLISH is now with the service department of Enterprise Engine & Foundry Co., San Francisco, Calif. Prior to this, he was an installation and service engineer with Nordberg Mfg. Co., Milwaukee, Wis., in the installation and service department.

SIDNEY G. HARRIS is now associated with the Graphite and Lubricants Division, Joseph Dixon Crucible Co., Jersey City, N. J. His major activity is in product research and development plus sales engineering. He is a former chairman of SAE Metropolitan Section, and during World War II was Lieutenant Colonel in the U. S. Army, functioning as a petroleum specialist. Previous connections were with Continental Motor Corp., Macmillan Petroleum Corp., Petroleum Solvents Corp., and Magnus Chemical Co.

KARL E. FREUND is now senior technical man (field service engineer) with The B. F. Goodrich Co., Akron, Ohio. Prior to this, he was west coast regional manager with Lord Mfg. Co., Burbank, Calif. His new position entails assisting aircraft manufacturers in the design and construction of self-sealing and non self-sealing fuel, oil, water, and alcohol non-metallic tanks for aircraft.

HAROLD W. CLOUD, previously works manager with the Oil Well Supply Co., Oil City, Pa., is now assistant to the president and factory manager at the American Bed and Spring Co., St. Louis, Mo. He has supervision over all manufacturing activities and related activities.

GORDON W. BOUSKILL, who, prior to this, was sales manager with Van Wagners Auto Electric, Ltd., Toronto, Canada, is now the owner of The Filter Supply Co. in that same city.

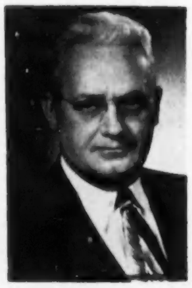
BERNARD W. POSEL is now employed by the Fletcher Aviation Corp., Pasadena, Calif., in the capacity of detail draftsman.

WILLIAM VAN DAM, formerly a product engineer with Sealed Power Corp., Muskegon, Mich., is now a sales engineer with that same company.

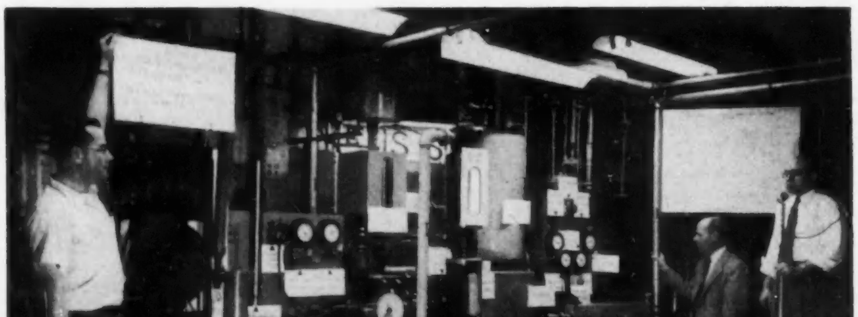
PAUL G. HOFFMAN, (left) former Studebaker president and more recently administrator of the Economic Cooperation Administration, has been named president of the Ford Foundation. He will direct its activities in "keeping the United States economy free" and "maintaining freedom abroad." **HENRY FORD II** is chairman of the board of trustees of the Foundation. Ford Foundation objectives aim at "establishment of a lasting peace throughout the world" and "achievement of democratic strength, stability and vitality." Foundation headquarters will remain in Detroit, but much of the staff work will be done in Pasadena, Calif., now Hoffman's home town. (Ford Foundation, reported to have assets of $250,000,000, was set up in 1936 by Henry Ford and his son Edsel.)

WILLIAM L. BATT, wartime production expert, has resigned as president of SKF Industries, Inc., to re-enter government service as chief of the Economic Cooperation Administration mission to the United Kingdom. Batt was very active in government work during the war, serving on the Business Advisory Council for the Department of Commerce, the National Defense Advisory Commission, the Office of Production Management, and the War Production Board.

E. CLAUDE JETER, whose appointment as manager of Ford Motor Co.'s new production foundry under construction at Cleveland, Ohio was announced in the November SAE Journal. Jeter joined the company soon after graduation from Clemson College in 1928. He has held various positions with Ford. Early in 1950, he was appointed manager of the production foundry and assumed the added responsibility of supervising the pattern shop.



WILLIAM A. BLUME has been elected a vice-president of the Thermoid Co., Trenton, N. J. He will be in charge of Thermoid's original equipment business for the automotive industry in Detroit. Prior to this, Blume was president of the American Brake-blok Division of American Brake Shoe Co. and a vice-president of the parent company.



DR. P. H. SCHWEITZER and research associates at The Pennsylvania State College, in cooperation with L. P. Sharples, of Philadelphia, working with the United States Air Force have developed a new system of lubrication for airplanes that makes possible flights in altitudes as high as 70,000 ft. A model system pictured above was recently demonstrated to leading aircraft manufacturers and representatives of the Air Materiel Command. Left to right are Frederick L. Hoffman, Jr., Dr. Schweitzer, and J. J. DeCarolis of the Engineering Experiment Station at Penn State.

GEORGE W. HAZEN, formerly with the Ordnance Department, Department of the Army, Washington, D. C., is now commanding officer at Miller Field, N. Y.

LT. COL. MILES A. KINLEY, formerly a graduate student at the University of Michigan, is now with the U. S. Army Ordnance Corps, Detroit Arsenal, Centerline, Mich.

MARTIN J. MURPHY, JR., formerly president and director of the Progress Electrolyte Co., is now vice-president and director of the Associated Battery Corp., Los Angeles, Calif. The company manufactures Associated, Olympic, Tepco, and Flight batteries.

BENJAMIN B. DUPONT, who, prior to this, was self employed, is now a designer in the Appearance Design Division of General Electric Co., Bridgeport, Conn.

HENRY B. REICH is presently a senior buyer with Ford Motor Co., Dearborn, Mich. He was previously an engineering coordinator.

L. E. WETZLER, previously a senior design engineer with the Cleveland Diesel Engine Division and the Diesel Equipment Division, GMC, is presently a research design engineer with Cummins Engine Co., Inc., Columbus, Ind. His new position entails new engine designing, the revamping of present engines and engine research.

PROFESSORS C. F. TAYLOR and **A. R. ROGOWSKI** of the Sloan Automotive Laboratory staff, presented papers on Diesel engine research at M.I.T. at an educational symposium on Diesel Engine Problems, held at the Massachusetts Institute of Technology on October 21, under the joint auspices of that institution and the Diesel Engine Manufacturers Association.

EMERSON W. CONLON, chairman of the department of aeronautical engineering at the University of Michigan, is on leave of absence for one year to act as technical director of the Arnold Engineering Development Center, Washington, D. C.

CLIFFORD M. RIGSBEE is leaving L. S. Ayres & Co., Indianapolis, Ind., after 25 years with the company, and is joining the RCA Service Co., Gloucester, N. J., as manager of the Commercial Service Section.

EDWARD RAY SEARBY is now general manager of the Chem Oil Co., Mt. Carmel, Ill. Chem Oil Co. is engaged in gathering, processing, and marketing residual crude oil. He was formerly with the engineering department of Cummins Engine Co., Columbus, Ind.

R. K. PEPPARD, formerly district supervisor in the Western Division with The Pennzoil Co., Kansas City, Mo., is now Southwestern Division Manager with that same company in Austin, Texas.

C. W. SQUELCH is vice-president and general manager of Motive Parts and Equipment Ltd., Toronto, Canada. Prior to this, he was general manager of Acme Bearings & Parts Ltd., Toronto.

ROBERT J. KRAUSE, previously a sales engineer with Pacific Division, Bendix Aviation Corp., North Hollywood, Calif., has been transferred to the New York office in a similar capacity.

EDWARD A. THEILE, JR., has severed his connections with White Truck Sales, and has joined Ruckstell California Sales Co.

EDGARD C. DESMET gave a discussion concerning modern day, practical application to the automotive industry of planography as a science of surface design, during the annual technical convention of the American Society of Body Engineers in Detroit, November 2. DeSmet, as director of body engineering, has the responsibility for planning and directing all body engineering at Willys-Overland, Toledo, Ohio.

RICHARD H. DeMOTT is now president of SKF Industries, Inc., Philadelphia. DeMott, who had been vice-president of sales since 1943, played an important part in pioneering the use of antifriction bearings in numerous industries.

JAMES C. ARMER, vice-president, Dominion Forge and Stamping Co. and Canadian Motor Lamp Co., was recently appointed president of the Canadian Industrial Preparedness Association. He is a past chairman of the SAE Canadian Section, and during World War II served as a member of several advisory committees to government wartime departments.

ERVIN N. (Bing) HATCH, chairman of SAE Metropolitan Section and a past vice-president of the Society, has been appointed head of the new Department of Franchises as Director of Transportation of Nassau County, Long Island, N. Y. He has been assistant to Col. Sidney H. Bingham, chairman of the New York City Board of Transportation, as senior automotive engineer. He has been active in Metropolitan Section for more than 15 years.

New Ethyl Corp. Assignments

New assignments affecting eleven SAE members have been announced by Ethyl Corp.: **HAROLD BERG**, Southern regional manager; **LEN HUXTABLE**, resident manager (Tulsa); **FRED NAYLOR**, assistant regional manager (West); **LOU SHANK**, sales coordinator; **CLIFF POPE**, manager gasoline testing; **BO WEILL**, resident manager (Los Angeles); **GEORGE ROSSER**, resident manager (Pittsburgh); **RAY WYRICK**, regional office manager (West); **GEORGE KRIEGER**, assistant manager chemical sales; **HARRY KUHE**, manager chemical sales; **BOB MEAD**, resident manager (Kansas City).


Berg


Huxtable


Naylor


Shank


Pope

Weill


Rosser


Wyrick


Krieger


Kuhe


Mead


J. E. TRAINER, a director of The Firestone Tire & Rubber Co. and its vice-president in charge of production, has been named vice-president for industry of the National Safety Council. Trainer, who became a member of the board of directors of the Council last year, has been active in promoting safety throughout his industrial career.

COL. WILLARD F. ROCKWELL, chairman of the board of Rockwell Mfg. Co., has been elected to the board of directors and to membership on the executive committee of the E. W. Bliss Co. Colonel Rockwell, one of the country's leading industrialists, is also chairman of the board of Timken-Detroit Axle, chairman of the board of Standard Steel Spring Co., and a director of more than twenty other corporations, banks and insurance companies. He is a member and also a director in several engineering and professional organizations.

W. D. HAZLETT, formerly administrative engineer at Aeroproducts Division, GMC, has established his own business as a manufacturer's representative in Dayton, Ohio. He is currently representing the Pacific Division of Bendix Aviation Corp., Benson Mfg. Co., Master Vibrator Co., and Haines Designed Products Corp.

DONALD T. ELLIS, identified with sales activities at Willys-Overland Motors, Inc., Toledo, Ohio, for the past five years, has been named to the administrative post of fleet and truck sales manager. Ellis first came to Willys as a cost analyst in manufacturing planning, later becoming staff assistant for distribution, assistant to the government sales manager, and then assistant manager of the fleet and equipment sales department.

MILES E. JOHNSON has accepted a position with the Ford Motor Co., Dearborn, Mich. The title of the new position is production contact engineer and he is stationed at Mound Road Plant, resident engineer's office.

ROBERT L. KNIGHT, formerly executive assistant at Motorola Research Laboratory, Phoenix, Ariz., is now a sales engineer with AiResearch Mfg. Co., Los Angeles, Calif.

E. B. MANSFIELD, formerly with Douglas & Mansfield, Houston, Texas, is now president of E. B. Mansfield Co., Consulting Engineers, in that same city.

H. D. MAC DONALD is now in charge of motor transport with the Royal Canadian Mounted Police, Vancouver, B. C. Prior to this, he was with the Transport Division of the British Columbia Police, also in Vancouver.

OTTO J. RISS, previously chief production engineer with the Cleveland Graphite Bronze Co., Cleveland, Ohio, is now with the same company in Fort Wayne, Ind.

Correction

The "Ted" Wells whose book "Scientific Sailboat Racing" was mentioned in the November number is T. A. Wells, vice-president and chief engineer of Beech Aircraft Corp., not E. C. Wells of Boeing as erroneously stated.

JAMES C. KRATZER, formerly head of the automotive laboratory at The Linde Air Products Co., Tonawanda, N. Y., is now employed by the National Carbon Division of Union Carbon and Carbide Co., New York, as an engineer.

JOHN G. MARSHALL has become president of Marshall Sales, Inc., Cleveland, Ohio, and vice-president of Central States Distributing Co. in that same city. Prior to this, he was district sales manager of Thompson Products, Inc., Chicago, Ill.

PAUL G. HOFFMAN, former administrator of the Economic Cooperation Administration, received the Captain Robert Dollar Memorial Award on Nov. 2. The award is given annually for distinguished service to the advancement of United States' foreign trade.

ROBERT F. LAY is now engaged in engineering design with North American Aviation, Inc., Los Angeles, Calif. Prior to this, he was an instructor at Purdue University, Lafayette, Ind.

HAWORTH W. HURT, formerly export manager with Air Associates, Inc., Teterboro, N. J., is now a consulting engineer with Pat V. Cooper & Co., Washington, D. C.

CHRISTIAN T. FEDDERSEN, who, prior to this, was a product engineer with the Fruehauf Trailer Co., Fort Wayne, Ind., is employed in production engineering with the Fisher Body Division, GMC, Detroit.

LT. GEN. JAMES H. DOOLITTLE, vice-president, Shell Union Oil Co., was joint recipient last month with Vice-Admiral Charles E. Rosendahl, and Jacquelene Cochrane, wartime leaders of the WASPS, of the Harmon International Aviation Trophy. Presented on the White House Grounds by President Harry S. Truman, the Trophy is indicative of top rating for an aviator, an aviatrix, and a balloonist during the 1940–1949 period. While Gen. Doolittle is the only member of SAE in the trio, both Admiral Rosendahl and Miss Cochrane have spoken before SAE national meeting audiences.

JOSEPH GESCHELIN will be one of the heads of the Engineering Society of Detroit Public Relations Committee for the coming year following appointment by the Society president. Geschelin is Detroit editor of Automotive Industries.

C. E. WILLIS, formerly eastern division manager with Lear, Inc., is now chief engineer with that same company in Grand Rapids, Mich.

DAVID G. WOODWARD, who, prior to this, was a junior industrial engineer with Carnegie Illinois Steel Corp., Irvin Works, Dravosburg, Pa., is presently an industrial engineer with Carnegie at the Vanderbilt plant, Vanderbilt, Pa.

CHRISTIAN SCHWARTZ is a civilian construction inspector with the U. S. Air Force at Selfridge Air Force Base in Michigan. His new position entails the inspection of new and existing construction work. Prior to this, he held a similar position with the Department of Public Works in Detroit, Mich.

RALPH S. ANDERSON, formerly a draftsman with the Autocar Co., Ardmore, Pa., is now a first-class draftsman with the Piasecki Helicopter Corp., Morton, Pa.

GEORGE W. DORR, formerly a mechanical engineer with the Naval Research Laboratory, Washington, D. C., is now an electrical engineer with the Navy Department in the Electrical Branch, Equipment Section, Washington.

WRIGHT A. PARKINS, engineering manager of Pratt & Whitney Aircraft, Division of United Aircraft Corp., has been named a member of the industry and educational advisory board of the U. S. Air Force's Arnold Engineering Development Center, Tullahoma, Tenn.

MICHAEL A. REMONDINO has been appointed technical representative covering the Eastern sales region and Canada for the Ethyl Corp. Research laboratories in Detroit. For the past year, Remondino has served as a research engineer in the commercial engine and fleet section of technical service, assisting in liaison activities between the manufacturers of commercial engines and vehicles and the petroleum industry. **HARRY A. TOULMIN, JR.**, formerly assigned to the Ethyl laboratories' automotive research operations division, succeeds Remondino in the commercial engine and fleet section.

PHILIP R. DENHAM, JR., is now an instructor at General Motors Institute, Flint, Mich. Prior to this, he was a test engineer at General Motors Proving Ground, Milford, Mich.

WALTER M. SCHAFFER, previously a project engineer with Towmotor Corp., Cleveland, Ohio, is now a major in the army. He is a group maintenance officer stationed at Fort Knox, Ky., and his duties include the supervision of maintenance functions of the ordnance group.

F. M. HAWLEY has been re-elected president and general manager, following a meeting of the board of directors of Morse Chain Co., a division of Borg-Warner Corp. **R. J. HOWISON**, formerly general sales manager, becomes vice-president in charge of sales, and **E. W. DECK**, formerly manager of the Ithaca Plant was named vice-president in charge of manufacturing, Ithaca.

DON V. EELS, plant manager, Cities Service Oil Co., Ponca City, Okla., had been appointed manager of the new terminal and compound plant of the Cities Service Oil Co. of Delaware at Chicago. Eels is a long time Cities Service employee, having joined the company in 1917.

T. E. DOUGHERTY, who joined the staff of General Motors Proving Ground on February 1, 1950, has recently been promoted to the position of assistant director of the Proving Ground. T. E. Dougherty or "Doc" as he is more commonly known, joined the Chevrolet Motor Division of General Motors in Flint, Mich., as a GMC institute student on October 30, 1928. In 1932, after graduating from G.M.I., he was transferred to the experimental laboratories of Chevrolet in Detroit. He was promoted to service contact engineer for Chevrolet Central Office in 1936. For nine years he handled all the transactions between the Service Field Organization and the Design Engineers.

F. WESLEY SMITH, recently New England manager for D. A. Stuart Oil Co., has opened his own consulting office in Holliston, Mass. He has spent 25 years in supervision of engineering and sales with major oil companies, and will specialize in lubricants and their applications. He was chairman of SAE New England Section (1946-47).

DONALD B. OLEN has been appointed to the newly created position of works manager of The Four Wheel Drive Auto Co., Clintonville, Wis. As works manager, he will have direct supervision of the engineering and manufacturing phases of Four Wheel Drive operations.

E. P. BLANCHARD, for many years director of sales of The Bullard Co., Bridgeport, Conn., retired September 29, after 30 years with the company. He has been connected with the "Forward New England " movement in economic research and analysis in production and marketing and has contributed articles to various papers on production, sales, business administration and economics, also, principles of integrated production and "Laws of Simulation."

E. VAN VECHTEN has been appointed manager of stores and purchasing at the Glendale plant of Grand Central Aircraft Co., Glendale, Calif. Van Vechten's years of experience in aviation maintenance, purchasing and sales started with a term in the Army Air Corps in 1917. He was instrumental in forming the CJW corporation which developed a widely used aircraft cargo- and load-securing device. He continues as a member of the board of directors of this firm.

SAE Father and Son

EARL L. MONSON (right), chief development engineer with Nash Kelvinator Corp., shown with his son Donald, who is special assignment engineer with Nash. Earl Monson has been with Nash Engineering for over 30 years.

BERTON A. PURDY is now a magneto engineer with Kiekhaefer Aeromarine Motors, Fond Du Lac, Wis. Prior to this, he held a similar position with Gale Products, Division of Outboard Marine Co., Galesburg, Ill.

ABRAHAM JACOBSON, previously job supervisor with the Department of Army, Ordnance Section Headquarters, is now Washington, D. C. representative of the Vimcar Sales Co., Los Angeles, Calif.

WILLIAM R. KENNEDY, JR., has been recalled to active duty by the U. S. Navy, and is at the U. S. Naval Station, Green Cove Springs, Fla. Prior to this, he was service manager with Pontiac Master Auto Service, Augusta, Ga.

MAX D. MURRAY, formerly a staff member of the Sandia Corp., Albuquerque, N. Mex., is presently field service representative with Wright Aeronautical Corp., Wood-Ridge, N. J., and is stationed at the Patuxent River Naval Air Test Center.

WALTER F. WHITEMAN is now engaged in methods and time study work with the Machine & Tool Designing Co. of Philadelphia. He is in charge of time study on the processing of ordinance parts. He also runs his own engineering consultant service on springs, suspensions, and machine and tool design.

PER ERIC ECKBERG, formerly assistant works manager with H. K. Porter Co., Inc., Pittsburgh, Pa., is now a research engineer with the Continental Can Co., Chicago, Ill.

HERBERT H. HOWELL resigned from the staff of the Johns Hopkins University Applied Physics Laboratory, Silver Spring, Md., in August, to accept a position on the staff of Arthur D. Little, Inc., Cambridge, Mass. His duties at Johns Hopkins were those of a contract representative, relative to a Navy-guided missile program, while his new duties with Arthur D. Little, Inc., are in the engineering sales field, relative to special equipment for research and industry, especially in the low-temperature field.

Students Enter Industry

GERALD W. DALDER (Wayne University '50) to Detroit Diesel Engine Division, GMC, Detroit.

ROBERT A. BJORKMANN (Stevens Institute of Technology '50) to Otis Elevator Co., Brooklyn, N. Y.

FRED G. BENNER (Bradley University '50) to Chicago, Milwaukee, St. Paul & Pacific Railroad Co., Chicago.

WILLIAM EVAN LITTLE (Purdue University '50) to Cadillac Motor Div. (GMC), Detroit.

CHARLES O. PARRATT (General Motors Institute '50) to Cleveland Diesel Engine Div. (GMC), Cleveland.

ARTHUR ROLLIN TAYLOR (University of Colorado '50) to General Electric Co., Lockland, Ohio.

GEORGE F. FRITZ (Northrop Aero Institute '50) to Douglas Aircraft Co., Inc., El Segundo, Calif.

WILLIAM J. SMITH, JR., (Aeronautical University '50) to Beech Aircraft Corp., Wichita, Kansas.

VERLE CLINTON AUSTIN (State College of Washington '50) to Boeing Airplane Co., Seattle, Wash.

JOSEF Y. DAHLSTRAND, JR. (Purdue University '50) to Dahlstrand Engineering Co., Inc., Indianapolis, Ind.

DAVID R. THOMSON (Purdue University '50) to Procter & Gamble, Cincinnati, Ohio.

JACOB WESLEY PRISER (Parks College '50) to The Glenn L. Martin Co., Baltimore.

CURTIS HAYES, JR. (Texas A and M College '50) to General Electric Co., Cincinnati, Ohio.

EMMETT WAYNE HORTON, JR. (Virginia Polytechnic Institute '50) to H. H. Robertson Co., Pittsburgh.

ROBERT F. HUNTER (University of Illinois '50) to Douglas Aircraft Co., Long Beach, Calif.

FRANCIS B. NYLAND (University of Washington '50) to Ford Motor Co., Seattle, Wash.

ROBERT H. OVERSMITH (Stanford University '50) to Consolidated-Vultee Aircraft Corp., San Diego, Calif.

CLAUDE MERRILL BARNARD, JR. (University of Southern California '50) to Anderson O'Brien Co., Los Angeles.

WILLIAM STEVE ALBERT (Fenn College '50) to The Park Drop Forge Co., Cleveland, Ohio.

RUSSELL F. MILLER (Parks College of Aero Technology, St. Louis University '50) to Melahn's Garage & Service Station, Mt. Kisco, N. Y.

Continued on Page 104

OBITUARIES

ARDEN W. LEFEVRE

Arden W. LeFevre, an employe of Stewart-Warner since 1924, and a vice-president since 1944, died July 21, following a protracted illness. In his quarter century with the Corporation, LeFevre rose from the position of draftsman-designer to engineering director of the company's largest division, and later, head of sales to car factories and other standard equipment users of Stewart-Warner products.

A former Oshkosh, Wis., resident, he was one of the last steamboat captains on Fox and Wolf river waterways. He and his brother Paul were captains on steamboats of the Clarke-LeFevre lines, founded about 1880 by their father.

NATHAN LESTER

Nathan Lester passed away on June 10. He was president of Lester Engineering Co. and Lester-Phoenix, Inc.

Starting his professional career as a mechanic and machinist first in Russia, he then came to this country. His experience ranged all the way from railroad trains to cigarette box machinery. He first became interested in die casting while working with Mergenthaler Linotype Co., and from that time until the time of his death, he devoted himself exclusively to the field of casting into dies and molds. One of the first injection molding machines supplied to the automotive industry was designed by Lester and displayed at the New York World's Fair in 1940 in the Ford exhibit. He was the holder of many patents in the field of die casting and injection molding, and in the course of his career he was associated with many of the largest dies casting companies operating today, including Doehler-Jarvis Corp., Precision Castings, General Electric, Westinghouse, and General Motors.

JOHN DALE THOMPSON

John Dale Thompson, for the last 19 years an engineer with Ethyl Corp., died on August 19 after a cerebral hemmorrhage. He was 42 years old.

Thompson joined Ethyl in 1930, shortly after his graduation from West Virginia University. He attended the Standard Oil Co. of New Jersey Training School and then joined the Yonkers laboratory as a CFR engine operator. After a few months, he went to the gasoline testing laboratory in New Orleans as a knock test engineer and moved with the staff to Baton Rouge when the new laboratory was built. In June 1942, he was transferred to the Detroit laboratories to assist with war work on aviation gasoline. After the war, he joined the Automotive Products Division, and until his death worked as a research engineer assigned to road knock-rating projects.

He belonged to Scabbard and Blade, as honorary military fraternity for engineers.

ARTHUR H. KANNADY

Arthur H. Kannady, 50, supervising fuel and lubricants engineer for the Standard Oil Co. of California in the Long Beach district area, died suddenly Sept. 1 at his home.

He was born in Boston, Mass., came to Long Beach, Calif., as a boy, and attended high school there for three years before enlisting in the Navy in World War I. After a varied 28-year career with Standard Oil Co., he returned to Long Beach in 1943 and joined Standard Oil in 1944.

GEORGE W. RUMFORD

George W. Rumford, pioneer automotive engineer and a prominent figure in the automobile industry for almost 50 years, died of a heart attack Aug. 3. He was 68 years old.

During his long career Rumford managed the Highland Park Maxwell plant, the Cadillac-La Salle plant, was general foreman for Chrysler and superintendent of the Chrysler Jefferson plant before going to De Soto in 1936. He retired from De Soto in 1947.

Since his retirement he had been president of the George Rumford Motor Sales Co.

ARTHUR H. TIMMERMAN

A. H. Timmerman, nationally known veteran of the electrical industry and, until March of this year, a vice-president of Wagner Electric Corp., died in Dallas, Texas on July 18 at the age of 79. He became ill while on a vacation trip, and had been in a Dallas hospital for several weeks prior to his death.

Timmerman was born in New York City in 1871 and graduated from the College of the City of New York in 1891 with a Bachelor of Science Degree. His industrial career began in 1899, when he joined the Wagner Co. He was chief engineer from 1908 to 1919 when he became vice-president, and in 1925 he was elected a director. He retired March 20, 1950 after fifty years with the company.

Throughout his career, Timmerman was active in organizations for improving the standards of the electrical industry. He had been a member of SAE since 1914.

EMIL H. PIRON

E. H. Piron, whose inventive genius was largely responsible for the mechanical success of the PCC Car, died October 6 at his home in Forest Hills, N. Y., after a long illness. He was 75 years old.

At the time of his death, Piron was chief engineer for Transit Research Corp., holder of the numerous patents that have been obtained on many features of the car. Piron joined the staff of the Electric Railway Presidents Conference Committee in 1931.

A native of Phillipeville, Belgium, Piron was a graduate of the University of Louvain, Belgium, as a mining and civil engineer. Early in his career he was employed by the Koppers Co. and worked in Belgium, Germany, Austria and Russia. He came to the United States in 1924 and was associated with the Ford Motor Co.; Noble & Harris, mechanical engineers of Detroit, Mich.; and the Detroit Edison Co.

E. PAUL duPONT

E. Paul duPont passed away September 26. He was 63 years old.

DuPont was born in Christiana Hundred, Delaware. He graduated from Episcopal Academy, Philadelphia, in 1905, and received his engineering degree from the University of Pennsylvania in 1909. He received his captain's commission in the Army Ordnance Reserve Corps in 1917. He was especially interested in mechanics and after the armistice decided to give up the manufacture of explosives and organized the duPont Automobile Co. of Wilmington, Del. In 1929 he became president of the Indian Motocycle Co. of Springfield, Mass. He held many patents and was the author of numerous articles on automobiles and their improvements.

At the time of his death he was a director of the Indian Motocycle Co., the Delaware Trust Co., the Franklin Institute, the Corinthian Yacht Club of Philadelphia, and a limited partner in the Francis I. duPont Co.

CALENDAR

Buffalo—Dec. 19

Sheraton Hotel; dinner 6:30 p.m. Meeting 8:00 p.m. Ladies Nite. Speaker to be announced.

Canadian—Dec. 20

Royal York Hotel, Toronto, Ont., Can.; dinner 7:00 p.m. Meeting 8:00 p.m. Christmas Party.

Central Illinois—Dec. 11

Jefferson Hotel; dinner 6:30 p.m. Meeting 7:45 p.m. Automatic Transmissions from a Practical Viewpoint—Alfred W. Sieving, transmission designer, Caterpillar Tractor Co. Selling Engineered Profit—John F. Findeisen, assistant sales manager, Eastern Division, Caterpillar Tractor Co.
(Date to be announced).

Cleveland—Dec. 11

Wade Park Manor. J. C. Rhoads, Division Engineer, Locomotive Engineering Division, General Electric Co., "The Gas Turbine Locomotive."

Colorado Group—January

Location to be announced. Meeting 7:30 p.m. Testing Fuels and Lubricants—L. C. Atchison, chief chemist, D. and R.G.W.R.R. and technical advisor, Rio Grande Motorway.

Metropolitan—Jan. 4

Meeting to be held at Brass Rail Restaurant. Dinner 6:30 p.m. Meeting 8:00 p.m.

Montreal—Jan. 5

Mount Royal Hotel, Montreal, Que., Can.; dinner 7:00 p.m. Meeting 7:45 p.m. Use of Propane Gas in Highway Transport—R. S. Lee, director of technical training, Twin Coach Co., Kent, Ohio.

New England—Jan. 2 and Feb. 6

Jan. 2—Fuels & Lubricants Meeting. Speaker to be announced.
Feb. 6—M.I.T. Graduate House; dinner 7:00 p.m. Meeting 7:30 p.m. American versus European Passenger Cars— Harry Stanton, editor, Boston Globe.

Oregon—Dec. 15

Members of SAE Oregon Section will be guests of Col. Jackson W. Lewis, Base Commander of Portland Army Air Base, and participate in an aircraft program being arranged for the Section by Col. Robert B. Asbury, and Public Relations Officer Lt. Robert Thompson. The SAE group will view and discuss cutaway models of the R2800 piston engine as well as jet powerplants. A speaker from Hamilton Field, Calif. will speak on jet engines.

Philadelphia—Dec. 13

Engineers Club, Philadelphia, Pa.; dinner 6:30 p.m. Meeting 7:45 p.m. The Development of Assault Transport and Troop Carrier Aircraft—Major Floyd J. Sweet, chief of the cargo unit, Aircraft and Guided Missiles Section, Engineering Division, Air Materiel Command.

St. Louis—Dec. 12

Congress Hotel, Union and Pershing; dinner 6:30 p.m. Meeting 8:00 p.m. R.R. Diesel Engines—R. W. Seniff, engineer of tests, Baltimore and Ohio R. R. Cocktail hour sponsored by Shell Oil Co.

Twin City—Jan. 10

Curtis Hotel, Solarium; dinner 6:30 p.m. Meeting 8:00 p.m. Development of Gas Turbine Electric Locomotives—J. C. Rhoads, division engineer, General Electric Co.
(Date to be announced).

Wichita—December

Droll's Grill; dinner 6:30 p.m. Meeting 8:00 p.m. Structural Testing of Large, High-Speed Aircraft—Harold Adams, structural testing, Boeing Airplane Co.

NATIONAL MEETINGS

MEETING	DATE	HOTEL
	1951	
ANNUAL MEETING and Engineering Display	Jan. 8-12	Book-Cadillac, Detroit
PASSENGER CAR, BODY, and MATERIALS	March 6-8	Book-Cadillac, Detroit
AERONAUTIC and AIRCRAFT Engine Display	April 16-18	Statler, New York City
SUMMER	June 3-8	French Lick Springs Hotel, French Lick, Ind.
WEST COAST	Aug. 13-15	Olympic, Seattle, Wash.
TRACTOR	Sept. 11-13	Schroeder, Milwaukee

SAE Section Meetings

Faster Helicopters Are Future Goal

• Southern New England Section
Robert E. Johansson, Field Editor

Oct. 3—Helicopters capable of operating in a speed range of 300-500 mph may now be considered as a definite goal in the future development of this type of aircraft, was the viewpoint expressed and supported by **Igor Sikorsky,** engineering manager, Sikorsky Aircraft, speaking before a capacity gathering at the opening meeting of the season.

Sikorsky said that accomplishment of this goal will undoubtedly be made by producing a "convertible" helicopter embodying its own unique principles for take-off and landing operations, plus characteristics of conventional aircraft for forward flight. Even today there are at least a dozen or more proposals which may be considered highly practical in achieving such an aircraft. Although recognized as a type of aircraft which will be inefficient as compared to performance standards of either the conventional airplane or the helicopter as we know them today, Sikorsky maintained that the extravagant expenditure of power required would be justified in emergency or military operations.

As for future development of the conventional helicopter, the speaker predicted that operating speeds of 140-175 mph while carrying 100 passengers, were a definite possibility.

Naturally, he said, many improvements and changes must be made before these claims become realities. For instance, loading factors used today must of necessity be greatly altered. Present day disc loadings of three lb per sq ft of blade disc area will have to approach seven to twelve lb per sq ft. On the other hand, loading factors of 12 lb per hp will become more on the order of five lb per hp.

Sikorsky added that use of jets for rotor propulsion will be helpful here. Use of compressed air carried to the blade tips and ejected was described as wasteful inasmuch as only some 150 hp for thrust purposes can be derived from an expenditure of 1000 hp at the center of the aircraft. With fuel added, it is conceivable that 750 hp could be developed for thrust purposes for 1000 hp at center. Torque compensating devices and transmission problems would be virtually eliminated through this use of jets for rotor propulsion. Nevertheless, he said that the high fuel consumption problem is still a formidible one.

In closing, the speaker emphasized that although the helicopter would never replace the conventional airplane, the future of rotary wing aircraft is tremendous. As a team worker in aviation, it is well established—as a universal vehicle, it is unsurpassed.

Further tribute was given to Sikorsky's achievements by Oliver Fitzwilliams, chief helicopter engineer, Westland Aircraft, Somerset, England, who was the international guest of the evening.

Photographed at the Oct. 3 meeting of the Southern New England Section are: (left to right) John J. Broderick, Section chairman; Oliver Fitzwilliams, chief helicopter engineer, Westland Aircraft, Somerset, England and the Section's international guest; Igor Sikorsky, the speaker; and Frank W. Caldwell, technical chairman

International Trade Fairs Become More Prevalent

• Canadian Section
A. H. Glionna, Field Editor

Sept. 29—"Only through better understanding brought about by trading with each other can we ever hope to have lasting world peace," C. E. Stevens, foreign operations division, International Harvester Co., Chicago, told members of the Canadian Section.

"Foreign trade is the medium through which, not only may the manufacturer increase his volume of sales today, but, of greater importance to all of us, it is the medium through which world economy can be improved," Stevens said.

He told the audience that although conditions are unsettled throughout the world, they must be faced with normal sound consideration and not in a state of panic.

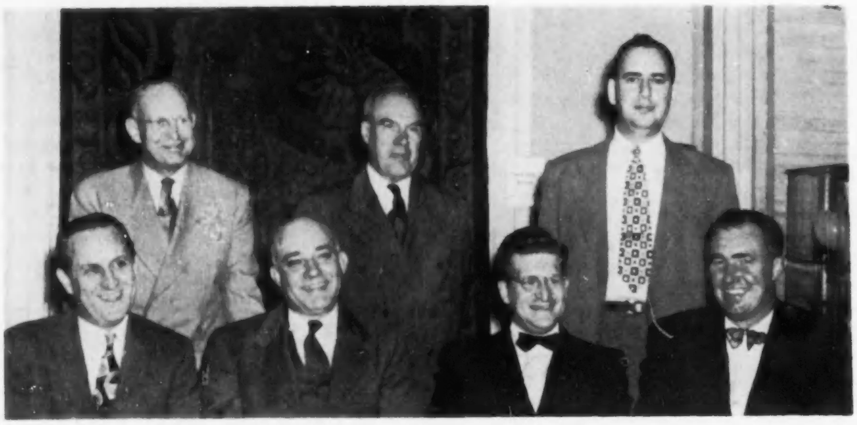
"When the going is a little rough we will get the job done just as well and probably better, if we keep our mind active, healthy and open to opportunities," he stated.

After briefly tracing the growth of trade from its early stages to the present day, Stevens observed that foreign trade has become a necessity and is growing in importance. He cited that additional proof of the increasing interest in international trade was exemplified by the Canadian International Trade Fair of 1950, and the first United States International Trade Fair at Chicago, last August.

Engine-Fuel Problems Due to Many Causes

• Detroit Section
W. F. Sherman, Field Editor

Oct. 4—Various aspects of the engine-fuel problems, both in technical and political areas, were discussed by authorities at the opening session of the Detroit Section's fall season. Also appearing at a dinner session in the



Syracuse Section officers and the Technology Club of Syracuse met on Oct. 9 to hear a talk by Carl T. Doman, about the organization of the Ford Motor Co. Left to right—standing: Charles Space, past president, Technology Club; SAE member Mark N. Russell, vice-president, Technology Club; Israel Katz, vice-chairman (Ithaca), Syracuse Section; and (left to right—seated): Jack Hummel, president, Technology Club; Speaker Carl T. Doman, national service manager, Ford Motor Co.; E. B. Watson, chairman; and Leslie Parkinson, vice-chairman, Syracuse Section

Rackham Memorial Building, a military commentator gave a close-up view of the impact of the Korean situation.

W. M. Holaday, Socony-Vacuum Laboratories, said that today there are about 10 individual processes being used in production of gasolines, contrasting with straight run distillation and thermal cracking 15 years ago. Reasons for development of these processes, what they do, and how they fit into the cost-quality-yield relationship was the subject of Holaday's talk.

Current consumption of petroleum products in the United States is nearly 600 gal per year per capita, or about 2000 gal per family. In large measure, increased automobile registrations and use account for this growth. On the average each vehicle now uses more than 800 gal of gasoline per year, said Holaday.

As demand for gasoline increased during the past decades, processes were developed to obtain increased yield from crude oil. Simple distillation was followed by thermal cracking which, quite unexpectedly, gave gasolines of higher anti-knock quality. However, as this process is increased in severity it also produces increased quantities of less valuable by-products. There followed such improvements as the Houdry catalytic process, catalytic polymerization—which gives gasoline an effective octane number well above 100 when blended with normal gasoline stocks, and an alkylation process—which is used where an aviation component is desired. Next came three processes designed to utilize straight-run gasoline as charge stock to make higher octane number gasoline. Thermal reforming, polyforming, and catalytic reforming processes are the types of processes used for this purpose.

Economics of refining are such that in general the processes which provide only improvement in octane number are the more costly. Holaday presented analyses to demonstrate how and why this is true.

His discussion illustrated these points—(1) level to which octane number can be raised with available refining processes and, (2) route which will be followed in going to higher octane number levels.

Military considerations are going to have serious effects on gasoline, he predicted. A decrease in octane number is scheduled by December of this year, and further decreases during 1951 are probable, he added.

V. G. Raviolo, engine assistant to the chief engineer, Ford Motor Co., reminded his listeners that engine development does not need to depend on fuel development, although progress to date has been the result of concurrent efforts of the petroleum and automotive industries. At the same time he remarked that engine development is not a substitute for fuel development.

Engines have more than the two qualities commonly mentioned—octane number requirement and compression ratio: Engines must be reliable, economical, durable, servicable, and produceable. The first of these assumptions is that "poppet valves are bad," because they are hot. He cited experimental data which "should dispose of the hot valve bogey once and for all." Then he dealt with the suggestion that engines would operate more efficiently if overall engine coolant temperatures were increased. Tests demonstrated a considerable loss of both bhp and torque, he reported.

About combustion chamber deposits he said, "we cannot yet explain all these effects, but we have these facts to face: A consistent 10% to 15% power loss, and increase in requirement of 6 to 10 octane numbers, and a 3% to 4% loss of economy cannot be overlooked."

The combination of automatic transmission and automatic choke makes the engine far more volatility-sensitive than it used to be, he told his audience. As a result of the variation of environment, operating conditions, and type of fuel, manifold design and development continues to be the most exacting job which faces the engine designer.

The military commentator, **Col. S. L. A. Marshall,** Detroit News, said that the results of our recurring wars indicate that as a nation we do not know how to use a victory. As to our preparations for defense, he said it is a great delusion to believe that engineering and productiveness are enough to win a war. Fundamentally, he added, there comes a time when it takes men willing to go forward. In the United States there is need for a greater dedication of Americans to the service of their country. We must give more, he declared, in order to endure.

Heavy Hydraulic Presses Shown On Plant Tour

• Detroit Section

W. F. Sherman, Field Editor

Oct. 23—A tour of the new USAF Manufacturing Methods Pilot Plant at Adrian, Mich., was a feature of the Detroit Sections meeting. **Lt.-Gen. K. B. Wolfe,** Deputy Chief of Staff, Material Hq., USAF, and **Alexander Zeitlin,** vice-president of Hydropress, Inc., were the speakers. The Gerity-Michigan Mfg. Co. was meeting host in the plant which it operates for the USAF.

Plant features were very heavy hydraulic forging and extrusion presses which are captured German equipment siezed by the United States as reparations at the end of World War II. The plant has other equipment necessary for processing aluminum, magnesium, and steel, in types of manufacturing research operations which are contemplated.

Wolfe provided background on development of the German heavy presses, and outlined purpose and scope of the manufacturing methods research program at Adrian. He announced an American program for developing heavy forging and extrusion presses which will cost approximately 200 million dollars.

Development of aluminum and magnesium resources, and exploration of methods for forming these metals, were a consequence of closing many foreign trade channels to Germany after World War I, Wolfe said. Characteristics of the metals led to utilization of extremely high pressures in forging and extrusion processes. German industry, for the most part, financed the

equipment and commercial applications which were developed. Availability of a 7000 ton vertical hydraulic press opened the avenue for design of larger parts. Then, a 15,000-ton press was erected and production of aircraft landing wheels, undercarriage parts, wing attachments, propeller blades, and crankcases was undertaken in volume. During World War II a 30,000-ton press was constructed, now possessed by the Russians.

The Air Force research program will enable American industry to proceed with design and try out of large forged parts, so they can be prepared to utilize new equipment to be built in the United States, exceeding even the biggest of the German presses, Wolfe indicated.

Zeitlin appeared in behalf of Edwin Loewy, president of Hydropress, Inc. He described construction and erection of the large presses in Germany and England, pointing out that press erection methods have improved in the past 20 years. He showed slides illustrating the outdoor erection of one of the first big presses.

In conclusion Zeitlin said that Russia has a four-year head start on the United States with the 30,000 ton press now installed, and we need a year and a half to catch up. Russia is also erecting a 55,000-ton extrusion press from German designs developed during World War II.

Montreal Section Holds Inaugural

Executives of Montreal Section with Canadian Section's chairman and speaker of the evening: Above, left to right: Secretary F. H. Moody; Vice-Chairman E. J. Cosford; and Treasurer H. L. Barre; Below, left to right: Canadian Section Chairman Col. Malcolm Jolley; Montreal Section Chairman W. S. Cowell; and Speaker H. E. Churchill, Studebaker Corp.

Light Passenger Cars More Maneuverable In Traffic

• Southern California
R. Strasser, Field Editor

Oct. 19—In a talk about light passenger cars of the 100 in. wheel base class, **L. H. Nagler**, technical advisor, Nash Motors Division, Nash-Kelvinator Corp., said that a study of basic transportation requirements — transportation for everyday use, was made by Nash Motors Division, immediately after World War II.

It was found as a result of this study that the car should be of reasonably full size to meet needs and wants of average families. The study also disclosed that overall length could be about 2 ft shorter than average low-priced cars built today, and that the wheelbase could be about 1 ft shorter. General performance should be as good as other cars on the road, but fuel economy was a necessity, according to Nagler.

To meet these requirements, a passenger car of the 100-in. wheel base class was designed. Fuel economy was achieved by making the car some 500 to 600 lb lighter than present average low priced cars. Nagler indicated the advantages of a light passenger car for driving. The shorter wheel base

Canadian Section Chairman Col. Malcolm Jolley Presents:

(1) An SAE Banner to Montreal Section Chairman, W. S. Cowell

(2) A past-chairman certificate to H. L. Hinchcliffe, British Columbia Section

(3) A past-chairman certificate to W. W. Taylor, Canadian Section

makes the car more maneuverable in traffic, and shorter overall length helps alleviate the parking problem, he said. Common public belief that light cars are unsafe for high speed driving can easily be changed by considering weight of race cars, such as those that are used at Indianapolis and other race tracks, he said. These race cars are hundreds of pounds lighter than average passenger cars, yet they travel at far greater speeds, he added.

The speaker pointed out that many families purchase a smaller light car as a second car, and soon discover that the lighter car not only meets their transportation needs, but due to its economy and ease of operation, the lighter car is more in demand by members of the family, than the larger car.

Propeller Noise Limits Naval Vessel Activity

• San Diego Section
Charles F. Derbyshire, Field Editor

Nov. 7—Effectiveness of naval vessels is limited by propeller noise, according to Capt. **W. P. Mowatt**, USN.

Mowatt said that studies are being made on variable pitch marine propellers, and results appear very promising. Development of high pressure, high performance boilers has greatly progressed since inception of this trend in the early thirties. Chief limitation at present is poor propeller performance, declared Mowatt. He pointed out that cavitation affects service life adversely. Hydraulic noise is a detriment to hunter-killer type ships, designed for pursuit and attack of submarines, because this type of noise is heard farthest by submarine listening devices.

Discussion centered around advisability of electric drive over reduction gear, with opinion still generally in favor of reduction gear because of its lower cost and lighter weight.

Longer Life Predicted For Exhaust Valves

• British Columbia Section
J. B. Tompkins, Field Editor

Oct. 9—"We can't talk about fuels without talking about the engines, and occasionally we must stop and take stock during discussions on motor fuels," said **Edwin C. Paige**, of the Ethyl Corp., Detroit research laboratories in a talk on the "Evaluation of Motor Fuels for High Compression Engines."

Tracing the development of motor fuels from the early 1920's to the present, Paige noted there is more efficient use of petroleum products as compression ratios increase. He reminded his audience that today's ratios average 6 to 1 with a high of 8 to 1, and looked for future compression ratios of 12 to 1.

According to Paige, an experiment conducted by his laboratories indicated that 1 gal of today's motor fuel does work of 3 gal of gasoline marketed in 1921. Tests were run on a 1921 Cadillac, completely restored to its original condition. Into its tank was poured 1921 gasoline—"reconstructed" by Ethyl's Detroit plant.

Engines today haven't more displacement than in 1925, claimed Paige. During this period compression ratios and hp have been raised. However,

Continued on Page 90

25 Years Ago

Facts and Opinions from SAE Journal of December, 1925

SAE Handbook to be Issued in Bound Volume.—A complete volume of the SAE Standards and Recommended Practices bound in limp imitation leather, will be sent to members in March, 1926, in place of the usual issue of new and superseding data sheets. Subsequent volumes will appear semi-annually.

■

A courteous gesture on the part of the Pennsylvania Section last month was presentation of a leather-bound note book to all those attending the SAE National Transportation Meeting in Philadelphia. Attendance totaled 325.

■

"All possible steps should be taken to encourage automobile owners to treat their transportation equipment as they do their teeth, thus assuring uninterrupted operation and greater utility of the product."—J. Willard Lord.

■

Discussing "New Devices for Improving Car Operation," Don Blanchard of Motor World Wholesale told the SAE-NACC Service Engineering meeting that "more attention is being paid to lubrication than any other phase of design. Progress in lubrication during the last year," he said, "has been toward (a) improving the quality of lubricant delivered to the bearing surfaces; (b) provision of adequate supply of lubricant under all conditions; (c) reduction of the frequency with which the bearings must be lubricated, and (d) elimination of the need for periodic inspection."

■

Argument about truck loading at the National Transportation Meeting brought from George H. Scragg the opinion that permitted loads should not be governed by the weight of the vehicle alone. "It is obvious," he said, "that a load of 30,000 lb carried on six wheels would do less damage than one of 26,000 lb carried on four; also that a 26,000 lb load traveling at 25 mph would do more damage than a 30,000 lb load traveling at 10 mph."

■

A possible solution to the headlight glare problem using an asymmetric suggested by H. M. Crane at a Detroit Section meeting: Rotate the lens in the right headlamp about 9 deg in the proper direction to lower the left-hand end of the projecting beam and to raise the right-hand end. A separate switch would permit extinguishment of the left headlight alone. With that headlight extinguished, the regular city driving or parking light in the low candlepower bulb furnishes a marker light for the left side of the car."

■

A special subcommittee of the Electrical Equipment Division of the Standards Committee has been appointed to review needed changes in existing passenger car standards for generator and starting-motor mountings—and to develop any new specifications necessary. It was agreed that the existing standards are not suitable for motorcoach service and that special mountings for the loads encountered in motor coach practice should be developed.

■

New clause approved for inclusion in SAE specifications for upholstery leather: "Not more than 15% of the hides supplied may have up to five patches. The patches shall be equal to the rest of the hide in strength and flexibility, shall be invisible from the finished side, and shall be waterproof. Weak or open veins and knife-cuts shall be reinforced and classed as patches."

Parks College Campus

SAE AT PARKS COLLEGE

STUDENT Branch members at Parks College of Aeronautical Technology are learning by actual practice the functions and advantages of SAE membership. They are well along in establishment of an SAE technical paper library to which all students have access for reference purposes. At each meeting, a prominent paper is chosen and a student presents it. This serves a dual purpose; important information is passed on to members, and students are given an opportunity to acquire experience in public speaking.

They participate widely, too, in other SAE events. At last year's National Fuels & Lubricants Meeting in St. Louis some of the members lent assistance at the request of SAE St. Louis Section. The Section's welcome mat is always out to students. This has made it possible for them to attend many meetings of interest, and to make valuable tours of McDonnell Aircraft Co., Venice Electrical Co., and similar installations in the area.

St. Louis Section held its April, 1949 meeting on the Parks campus; students reciprocated by conducting tours of campus facilities, then held a student paper contest judged by Section members.

The SAE Branch at Parks College grew from the closely allied interests of Parks students and SAE, and the earnest efforts of Frank Myers, a Parks instructor in metals fabrication, who fostered and guided the Branch in its infancy. The first assembly of interested students took place on April 10, 1947. Present were students from many states in the Union and from foreign countries—all pursuing courses in aeronautical engineering, aircraft maintenance engineering, and air transportation.

The Branch assembles the second Thursday of each month for regular meetings, and holds a business meeting each six months to elect new officers and a faculty adviser (now Assistant Professor J. T. Harrington).

The program committee works hard to arrange informative and educational meetings and functions designed to promote the arts and sciences and engineering practices connected with design, construction, and utilization of automotive apparatus. Aviation films are common on the program agenda, and picnics are important features during the summer months.

SAE Members Who Attended Parks College of Aeronautical Technology Include:

Edward H. Barker (**1937-39**), Edward T. Boggs (**1946-48**), Brian E. Boyle (**1946-48**), Arthur Bruce Cook (**1946-49**), Leonard A. Cromer, Jr. (**1946-48**), John B. Dydiw (**1938-40**), Harvey D. Ferris (**1947-49**), Chester Grabarek (**1945-48**), Thomas C. Greenfield (**1946-49**), William M. Groover (**1945-47**), Charles J. Hager, Jr. (**1946-49**), John Thomas Harrington (**1938-40**), S. T. Horn (**1937-39**), Charles M. Jamieson (**1936-38**).

Malcolm K. Johnson (**1946-48**), Robert C. Kriete (**1946-48**), Eugene Kropf (**1938-40**), Clayton B. Leach (**1930-34**), William I. Marble (**1942-45**), Robert J. Marhefka (**1943-44, 1946-47**), Chester E. McCullough, Jr. (**1946-49**), Raymond A. Miller (**1929-30**), Steve R. Muza (**1941-43**), John Richard Mylin (**1946-48**), Duane Martin Phillips (**1946-49**).

David S. Sandow (**1946-48**), Lester B. Searer, Jr. (**1946-48**), Arthur T. M. Southart (**1937-39**), Albert D. Trager (**1940-42**), Robert W. Travis (**1946-49**), Raymond W. Walchli (**1943-47**), Thomas M. Wells (**1930-34**), Frank T. Zuch (**1945-47**).

Continued from Page 88

since 1935, engine displacements in buses have been boosted some 70% with resultant increases in engine output due to changes in weight regulations, he added.

Paige forecasted for exhaust valves, a life equal to that of piston rings, if present progress continues. He outlined variations in valve lash at various engine temperatures, and used slides to show comparisons of valve temperatures with and without leaks.

Unbiased Tests At GM Proving Ground

• Pittsburgh Section
H. K. Siefers, Field Editor

Oct. 24—The expressed function of General Motors Proving Ground is to provide: (1) a place to develop and test new components under actual service conditions; and (2) means for running unbiased tests on General Motors and competitive cars; revealed **Louis C. Lundstrom**, head of mechanical engineering department for General Motors Proving Ground.

Lundstrom emphasized advanced design and ease of installing the numerous instruments which automatically record test data during a Proving Ground run.

He indicated that testing is for both durability and performance. A complete durability test of 25,000 miles can be run in about four months, and includes dissembling and inspection of all parts before and after the test. In regard to performance, Lundstrom observed that the motoring public still seems to demand performance over economy.

Some highlights of a color film that was shown were: (1) high speed operation of the speed loop; (2) durability testing on the hill route; (3) performance testing on the straight-a-ways; (4) shake-down tests on the block roads; (5) seal tests on the mud road and bathtub; (6) tests of body structure on roll-over tests; (7) tests of car handling during actual tire blowouts.

Basic Design Evolved Into Efficient Powerplant

• Mohawk-Hudson Group
Frank Baker, Field Editor

Oct. 11—SAE Section Members at the season's first meeting heard **J. C. Miller, Jr.**, manager, research and refinement, The Cummins Engine Co., tell about the labor and perseverance involved in modifying a commercial truck engine design into a high-output, light-weight engine, suitable for a racing car to run at the 500-mile Indianapolis race.

When the engine under discussion was first applied commercially, it was grossly misused due to misplaced optimism of the operators, who tried to use this engine in competition with more powerful gasoline engines. To increase output, the cylinder bore was changed to 4 in. and the engine rated at 100 hp at 2200 rpm, said Miller.

World War II curtailed any further development of the engine. At the war's end work was resumed.

After much research and labor it was deemed possible to construct an engine, and a Kurtis Kraft chassis was procured. The engineering staff then started a testing program to prove their engine.

The racer ran for the first time on May 1, 1950. On the track the engine developed cooling trouble which was rectified by installing a new radiator and nose section. Final output was 320 hp at 400 rpm. Due to the air scoop to the supercharger on the front of the car, a "ramming" effect was obtained which permitted the engine to run on the track with an absolutely clean exhaust, Miller explained. After numerous alterations, the car qualified

at 29.208 mph on May 26, 1950.

(This paper was presented also at the SAE National West Coast Meeting. Excerpts appear in the October SAE Journal.)

See Modern Maintenance Shop On Inspection Trip

• Washington Section
Louis Reznek, Field Editor

Oct. 17—Members of the Washington Section, in a joint inspection trip and meeting, found out what it takes to keep streets and alleys of the Nation's Capital clean. This inspection trip was made to the new one and a half million dollar maintenance shop of the D. C. Department of Sanitation. An explanation of the operation was made by assistant superintendent, **Thomas Bishton,** at a dinner meeting at the Burlington Hotel.

According to Bishton, some problems faced by the department are: (1) disposal of 24,000 truck-loads of leaves a year; (2) what to do with three and one half million yards of trash a year; (3) maintenance of garbage trucks, averaging 1600 stops a day.

The answer insofar as mechanical equipment is concerned is a modern maintenance shop containing 105,000 sq. ft. of floor space. It contains facilities running from sheet metal shops to chassis dynamometers, and equipment ranging from modern vacuum leaf collectors and pulverizers, which replace three brush and shovel crews, to trucks as old as 1918 models. There are indoor storage facilities for 150 vehicles in the garage. Another part has heated rooms for drying paint jobs and an air conditioned section for parts storage, containing 28,000 sq. ft.

Future Advantages Of Gas Turbine Locomotive

• Philadelphia Section
M. A. Hutelmyer, Field Editor

Oct. 11—The cause for the jet engine was presented by **A. W. Gabriel,** installation engineer, aviation gas turbine division, Westinghouse Electric Corp., in a talk "Gas Turbines in Air and Ground Transportation," given with **J. O. Stephens,** design engineer, gas turbine locomotive, steam division, of the same company.

After describing the basic airplane engine as originally designed, Gabriel traced its development up to the present day. He pointed out that the engine had not only been increased in size and efficiency, but various accessories, such as the after-burner for increasing output at high altitudes, pressurizing equipment for the cabin, air bleeds for anti-icing, and so forth had been added, while the original simple engine was becoming more complex and bulky. The fuselage had been so reduced in size as to render the application of the powerplant a key problem. To quote Gabriel, "It is now necessary to mount a 40-in. motor in a 35-in. hole."

Stephens described a 4000-hp gas turbine locomotive, which Westinghouse has built for experimental demonstration purposes. The locomotive is now being tested at Pittsburgh, burning residual fuel oil. It is planned that the unit will soon be placed in road service as an experimental demonstrator. A general description of the locomotive arrangement, given by Stephens, included the gas turbine, fuel supply, electrical equipment, controls, (which are essentially the same as used on a diesel locomotive) and train heating equipment which utilizes the waste heat of one of the gas turbines. Stephens compared the diesel and gas turbine locomotives.

He pointed out that future advantages of the gas turbine are expected to be lighter weight, decreased maintenance, and lower first cost as size increases.

Columbium Shortage Shows Need For Conservation

• San Diego Section
C. F. Derbyshire, Field Editor

Oct. 10—Seriousness of the conservation problem can be best illustrated by the columbium shortage which became apparent as early as 1944 during World War II, said **John Tyrell**, research metallurgist, Solar Aircraft Co., speaking on "Conservation of Columbium."

Columbium is probably one of the best known alloying agents for prevention of intergranular corrosion in strategic alloys, Tyrell said. In 1944 our country had available a bank of approximately 1,000,000 lb of columbium. This material was being used at a rate in excess of 100,000 lb per month, with a bank replacement of only 50,000 lb per month. Since all our columbium is imported, a shortage was imminent. According to Tyrell, the shortage was in general brought about by lack of foresight and lack of fundamental research.

At the present time, columbium is more strategic than ever before, Tyrell declared. Therefore, it is quite obvious that now while we have time, steps should be taken to conserve this and other strategic metals by determining if alloys with less strategic materials can be substituted, he said. Tyrell has examined the problem of conservation of columbium quite thoroughly, and found the titanium stabilized steel, Type 321, can be substituted for columbium stabilized steel, Type 347, in aircraft components. In his opinion, this substitution can be made because experience at Solar Aircraft shows little or no difference in service behavior in these components operating up to about 1500 F.

Traces History Of Synthetic Rubber

• Canadian Section
A. H. Clionna, Field Editor

Oct. 18—"I predict that use of chemical rubbers will expand greatly during the next few years, and that the decade 1950–1960 will see world consumption of new rubber above two million tons per year," said **E. R. Rowzee** in his talk "Synthetic Rubber Comes of Age."

The manager of Polymer Corp., Ltd., Sarnia, Ontario, traced the history of synthetic rubber back to fundamental

research in Britain in the 1880's, which led to its discovery. Key developments in growth of the industry, he said, were discovery that isoprene could be polymerized to form a synthetic rubber; production of neoprene by duPont in the 1920's; wartime development of German buna rubbers and GR-S; and Butyl discoveries by United States and Canada during the same period.

The speaker gave the following reasons for his confidence in the firm position of the synthetic rubber industry: eight years experience with the product have given consumers a working knowledge of its advantages and weaknesses; "synthetic rubbers have improved markedly during the past several years and . . . will continue to improve; it is certain that synthetic rubber has achieved a degree of price stability which natural rubber cannot hope to match."

Heavy Sales of Henry J Predicted By Manhardt

• Buffalo Section
D. C. Appelby, Field Editor

Oct. 19—Seven years of development have preceded introduction of the Henry J, Kaiser-Frazer's recent entry in the low priced automotive field, said **A. E. Manhardt**, merchandising and sales promotional manager, Kaiser-Frazer Sales Corp., Buffalo area.

Over 50 members and guests heard Manhardt describe the original objectives of Kaiser-Frazer as wanting to fill the need for a low priced car that would meet public demand for price, performance, and appearance.

Manhardt claimed that a judicious balance of weight and power makes permormance outstanding. The styling has resulted from an intensive study of satisfying eye appeal, yet eliminating costly frills. Delivered prices are claimed to be lowest offered for a standard tread car in this country, according to Manhardt.

Maintenance of Lateral Stability Becomes Problem

• Northwest Section
K. A. Short, Field Editor

Oct. 6—The period from 1934 to the present time is described as an era of development in automotive suspensions, resulting in the practical standardization on long and short arm with coil spring type of front suspension, according to **W. L. Norris**, chief engineer, The Gabriel Co., in a paper "Modern Automotive Suspensions."

In addition to the Dubonnet suspension, a number of other arrangements utilized a softer leaf spring with torque arms to free the spring of braking stresses, have been tried and abandoned, said Norris. He called attention to the fact that European manufacturers, with their much smaller volume of production, could and did gamble with many unorthodox designs in their search for riding comfort. American manufacturers, he said, were extremely cautious in that respect.

Soft ride, with very low deflection rate springs, has reached a limit in American cars, with the frequency of oscillation just slightly higher than that which produces sea-sickness for many people, said Norris. Difficulty of maintaining lateral stability, especially on turns, has become a problem with use of soft springs and various types of sway bars, as well as positioning of shock absorbers to assist in eliminating sway. Some objections to leaf springs have been overcome by use of spring covers to retain lubricants and keep water and dirt out. Use is made of inserts between the leaves to prevent squeaks. At least one manufacturer has announced intention of returning to leaf springs in the rear. One effect of the soft ride has been to make shock absorbers much more necessary, both from riding and handling standpoints. The direct acting type is coming into more general use.

According to Norris, the chief obstacle in use of steel torsion bar springs seems to be in expensive methods required to anchor the ends. Changes in behavior with temperature changes, and need for more dampening, have restricted use of the rubber type.

Preventive Maintenance Begins Before Purchase

• New England Section
James S. Walker, Field Editor

Oct. 3—Members at the Section's first meeting heard **Gustave Heiber**, vice-president, maintenance, Boston & Worcester St. Railway, give information on "Preventive Maintenance" and how to put it to work on vehicles.

In Heiber's opinion, the whole of preventive maintenance hinges upon vehicle mileage. Whether it is engine hours, actual miles, or other means of measuring mileage, vehicle and vehicle unit records have to be kept. Heiber felt that only by keeping mileage records is a maintenance man in a position to know cost of operation and wear and service received.

Heiber said that preventive maintenance could begin before a vehicle or apparatus is bought, by keeping in

mind some of the following items: (1) size of vehicle—of what is load composed? (2) power plant—diesel, gasoline—type of terrain, length of run, type of operation, fuel cost, and so-forth; (3) oil filter—make, type, servicing; (4) fuel pump—electrical, mechanical, submerged type? (5) clutch—size, stop, go operation, hills, drivers? (6) transmission—three or four speed, short, long hauls? (7) rear axle ratio—fuel economy, speed, power; (8) brake drums—lining, servicing, life of parts; (9) tires, wheels—size, shape, rims; (10) air pumps—Wagner, Westinghouse? (11) windshield wipers—poor quality means more maintenance; (12) defrosting fans; (13) generator system—direct, alternating, Auto-lite, Leece-Neville, Delco? (14) heaters; (15) drivers seat—comfortable, adjustable, easily repaired? (16) floor covering—important in Heiber's operation; cheap flooring means increased maintenance.

He summed up by stating that an organized P.M. system will promote the following: (1) safety; (2) economy; (3) good public relations; (4) co-operation between departments; (5) morale of employees. An organized P.M. system can determine the following: (1) cost per unit; (2) oil and gas mileage; (3) life of various units; (4) unit changes; (5) early failure of unit; (6) saving of engines due to oil record; (7) better workmanship; (8) manufacturer will give more consideration to replacement for failure complaints, if accurate records can be shown.

Electro-Pneumatic System Described By Hudson

• San Diego Section
Charles F. Derbyshire

Sept. 22—Best ice removal means for airplane wings is electro-pneumatic system, according to **Vic Hudson**, thermodynamicist at Consolidated-Vultee Aircraft Corp., San Diego, Calif.

Hudson told members and guests that this system, consisting of a strip heater at the leading edge of the wing, with a margin of small pneumatic cells above and below, provides both the heat and deformation necessary for effective ice removal.

The thermal wing sandwich, consisting of two layers in the skin, is desirable for aluminum skin materials, because of low unit heat. It is undesirable because of high heat requirement for effectivity.

He added that the porous heating edge, now under development at Convair, shows promise as a good heat conserver and effective anti-icing means.

Section Membership Chairman, Dan Sanborn, along with the committee, were congratulated on their showing of new members.

Combustion Engine Research Discussed

• Mid-Continent Section
D. W. Frison, Field Editor

Oct. 6—Recent developments in combustion engine research indicate that manifestations of precombustion reactions are affected by both physical and chemical variables in much the same manner as these variables affect knock in a fired engine, **D. L. Pastell** told a group of 60 student and regular members.

The director of combustion research group for E. I. duPont de Nemours & Co. discussed the effect of pertinent variables on the extent of precombustion reaction, as measured by the

charge in cycle pressures, and physical conditions required for cool flames and auto-ignition. A correlation between knock in a fired engine and auto-ignition in the motored engine was also developed.

According to Pastell, for these and other reasons a motored engine makes an ideal reactor for end gas reaction studies.

Pastell originally discussed this subject at the Summer Meeting in French Lick, Ind. An abstract of his paper appeared in the Sept., 1950 SAE Journal. The complete paper appeared in the Oct., 1950 SAE Quarterly Transactions.

Methods Used For Cooling Automatic Transmission

• Chicago Section
M. P. deBlumenthal

Oct. 10—Significant features of the currently available automatic transmissions were reviewed by **D. T. Sicklesteel,** vice-president, Detroit gear division, Borg-Warner Corp., before one of the largest "open meetings" of the Chicago Section's season.

Sicklesteel traced the similarities and differences existing in present day automatic and semi-automatic transmissions systems. Starting his discussion with features of the Warner Overdrive, he pointed out that to date over eight million various types of automatic and semi-automatic transmissions have been produced, with the daily production rate over ten thousand units. Currently, Overdrive, Hydramatic, and Chrysler units are leading the way with 3,500,000; 2,500,000; and 1,450,000 units in use respectively.

Talking entirely from slides, Sicklesteel described the Chrysler type of unit employing fluid coupling, friction clutch, and hydraulically operated four speed transmission.

Stating that in all of the automatic units there are many similarities, Sicklesteel described the basic epicycling gear train, and various methods used to control several elements of this train, to achieve desired forward or reverse ratios. He further presented the basic similarities in hydraulic systems of the various transmissions.

Hydramatic, Dynaflow, Powerglide, Ultramatic, Studebaker, and Ford units were briefly described by Sicklesteel, who pointed out many features in each of the above units. A detailed description of the torque converter applications and design was given in instances above, where one is used, stressing the fact that industry at present is in disagreement as to whether the final drive is to be entirely through fluid or locked out. He cited Packard and Studebaker examples of the latter trend.

Differences in positions taken by various manufacturers for cooling of the automatic transmission were brought out. Currently, the Dynaflow, and Ultramatic use engine water as means of keeping the transmission cool. Studebaker, Ford, and Chrysler employ an independent air cooling system.

Manufacturing Techniques In Radio Tube Fabrication

• Williamsport Group
Carmine Pinto, Field Editor

Nov. 6—In a field that is highly competitive, it is necessary to obtain quality on a mass production basis, said **H. G. Hartwell** of Sylvania Electric Products, in describing the manu-

facturing techniques involved in fabrication of radio tubes.

This requires specialized machinery for fabrication of radio tube components, such as flares, stems, exhaust tubes, and so forth. Products from the high production machinery are analyzed and charted at regular intervals to determine the quality produced, and any indication of variances from specification requirements.

In describing the Sylvania Mill Hall plant, Hartwell said that it produces glass tubes in types known as the bantam, lock-in, and miniature. This company also produces sub-miniature types. Statistical methods of quality control are utilized to detect defects and are used as a "yardstick" to minimize shrinkage, which averages at about 10% of production runs at predetermined intervals. If the processes are controlled, sampling inspection can also be applied to the finished product with reasonable assurance of adequate quality levels. This eliminated need for 100% inspection of the final product wherein the defects are screened and whereby without process control, it may readily be seen that mass quantities of shrinkage can be produced before corrective action is taken at process, Hartwell concluded.

New Plane Features Detachable Fuselage

• Metropolitan Section
Charles Foell, Field Editor

Nov. 2—Numerous possible adaptations for the new Fairchild XC-120 detachable fuselage Packplane were outlined by two of the plane's designers, **George W. Lescher** and **James A. Sterhardt**, aeronautical engineers, aircraft division of the Fairchild Engine & Aircraft Corp., in a paper they presented before the Metropolitan Section.

Various Adaptations

For example, they said, "the ultimate adaptation of the load detachability principle will find its greatest field, like tractor-trailers, in bulk moving of goods or materials with the pack, whatever its form, serving not only as a containing element for loading and unloading and while in transit, but also serving for temporary storage at terminals."

They said that by means of a standardized trailer chassis made specifically to accommodate the pack, it may be made adaptable for long-distance transport by air carrier and transit to local destinations by tractor-trailer.

Beyond the mere transportation of troops, the detachable transport system can also handle heavy military vehicles, armament, ammunition, engines, spare parts, light armored tanks, and other military cargos.

An interesting possible military application for assault purposes, they declared, is the dropping of entire loaded packs while in flight. Technical problems involved in maintaining stability and level attitude of the pack during descent, controlled deceleration near the ground, and shock absorption upon ground contact, while challenging, do not seem to be unsurmountable, they pointed out.

Jettisoning troop-loaded assault water-planing packs from just above the surface of water, headed toward beachheads under assault, may be possible.

The carrier may also be utilized without the pack as such; for carry-

ing exceptional items like poles or beams, cradles or racks attached at the standard carrier attachment points could be used in place of packs.

Lescher and Sterhardt said that neither Fairchild nor the Air Force regards the XC-120 as the final step in air transport revolution. Rather, they said it represents primarily and almost solely the physical embodiment of the principle of detachability of the load from its carrier.

Gas Turbines Have Future In Trucks

• Central Illinois Section
Harlow Piper, Field Editor

Oct. 24—We should not expect to have gas turbines in our cars for a long time, according to Dr. **J. T. Rettaliata,** vice-president and Dean of the Illinois Institute of Technology, who spoke before this Section in Springfield, Illinois.

For a 300-mile trip, a gas turbine car would require about 290 gal of fuel, and would cost four cents a mile to run, stated Rettaliata.

Additional Problems

However, he said the gas turbine has a future in trucks because it takes up about 13% of volume and weighs about one ton less than a diesel engine of same power.

Main problems in adapting the gas turbine to locomotives have been burning pulverized coal under pressure and separating the fly ash. Fly ash can cut the turbine blades in two within 24 hr.

The gas turbine has received the greatest publicity in airplanes, where its greatest efficiency can be used at higher speeds.

SAE Student News

Oklahoma A. & M. College

Rebuilding of old parts is half as costly as manufacturing new ones, declared **Lewis Lee,** manager, Fred Jones Mfg. Co., at the Oct. 12 meeting.

According to Lee, Ford recommends rebuilding of old parts in preference to the precision required of new parts. This process is less expensive; thereby giving owners a reduction in operating cost. Lee described the precision that is exercised in Ford rebuilding plants. Car engines are guaranteed to give satisfactory service for 20,000 miles.

A film, "The Human Bridge," pictured manufacture of the passenger car, from drawing board to finished product.

During the latter part of the meeting, George Welch gave a lecture on the history of the carburetor and some problems of keeping it functioning correctly. Three major troubles of carburetion were said to result from carbon, gum, and worn parts.

—Bill R. Longpine, Field Editor

San Diego State College

At the Oct. 5 meeting, 17 students heard Student Committee Chairman **Vaughan De Kirby** of the San Diego Section speak.

De Kirby, design engineer, San Diego Division, Consolidated-Vultee Aircraft Corp., spoke of the student chapter's place in the SAE and assured the group that they had the complete backing of the San Diego Section.

A large group of students and faculty listened to Paul Carlson, project engineer, Solar Aircraft, deliver a talk on "50 Kilowatt Gas Turbine Driven Aircraft Power Units," on Oct. 19.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STAMPINGS • UNIVERSAL JOINTS • SPICER "BROWN-LIPE" GEAR BOXES • RAILWAY GENERATOR DRIVES

Students Enter Industry

Continued from Page 83

JOHN ROBERT ADAMIC (Michigan State College '50) to Ternstedt Division, GMC, Detroit.

HAROLD WILLIAM AUSTROW (University of Michigan '50) to Kaiser-Frazer Corp., Willow Run, Mich.

MYRON A. CHOTKOWSKI (University of Massachusetts '50) to General Electric Co., Lynn, Mass.

ROBERT G. DAVIS (Purdue University '50) to Chevrolet Commercial Truck Body, Indianapolis, Ind.

PAUL CONNERS DILLMAN (UCLA '50) to Lockheed Aircraft Co., Burbank, Calif.

RAYMOND DEAN HUFFMAN (Bradley University '50) to Caterpillar Tractor Co., Peoria, Ill.

FRANK WILLIAM BALL, JR. (Purdue University '50) to Oldsmobile Motor Works, Lansing, Mich.

ERAL WILLIAM CHUTE (Lawrence Institute of Technology '50) to Detroit Tank Arsenal, Center Line, Mich.

WILLIAM V. CHAMBERS (Bradley University '50) to General Electric Co., Lynn, Mass.

WILLIAM GIBSON CAMPBELL (Lehigh University '50) to Heintz Mfg. Co., Philadelphia.

J. R. CAVERHILL (University of British Columbia '50) to International Harvester Co., Ltd., Hamilton, Ont.

WILLIAM C. GRISLEY (Purdue University '50) to United States Rubber Co., Indianapolis.

TRUMAN F. BARBIER, JR., (Michigan College of Mining & Technology '50) to Barbier & Dulmage, Inc., Detroit.

ERNEST IGNATIUS WROBLEWSKI (Purdue University '50) to Witt Engineering Co., South Bend, Ind.

JOSEPH VOORHEIS ROGERS (University of Michigan '50) to Dodge Truck Div., Chrysler Motor Corp., Detroit.

MON W. FONG (University of Southern California '50) to Douglas Aircraft Co., El Segundo, Calif.

JAMES ALFRED WOOD (Tri-State College '50) to American Rock Wool Corp., Wabash, Ind.

JAMES FRANCIS PETROSIUS (Illinois Institute of Technology '50) to Associated Valve & Engineering Co., Chicago.

CLAYTON CHARLES WOOD, JR., (Cornell University '50) to United States Gypsum Co., Oakfield, N. Y.

RICHARD W. NICHOLAS (Lawrence Institute of Technology '50) to Fisher Body Div. (GMC), Detroit.

EDWARD N. MINER (University of Illinois '50) to Automatic Electric Co., Chicago.

WILLIAM A. MICHAELS (Ohio State University '50) to Bryant Heater Div., Affiliated Gas Equipment Inc., Cleveland.

ROBERT FRED LURIE (University of Illinois '50) to Commonwealth Edison Co., Chicago.

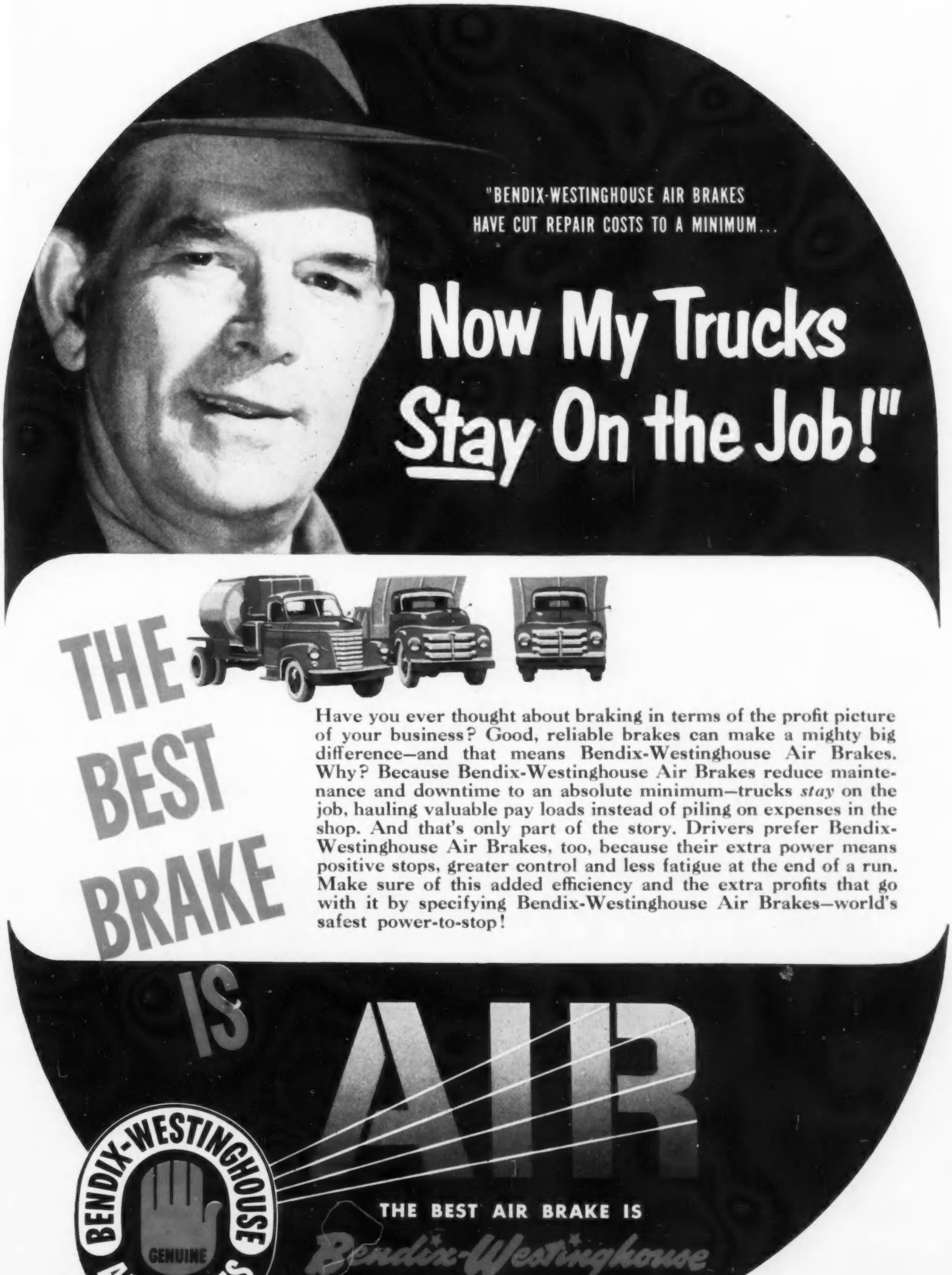
FRANCIS I. BARATTA (University of Massachusetts '50) to F. W. Sickels Co., Chicopee, Mass.

THOMAS JAMES AITKEN, JR., (Manhattan College '50) to Bendix Aviation Corp., Teterboro, N. J.

CHARLES GERALD BREEDING (Oregon State College '50) to Mobilift Corp., Portland, Oregon.

JOHN C. PRATT (Lawrence Institute of Technology '50) to Continental Aviation Engineering Corp., Detroit.

HAROLD K. JOHNSON (University of Toronto '50) to The Imperial Pipe Line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ELYRIA, OHIO

Co., Ltd., Redinater, Alberta, Canada.

JOHN G. JOHNSON (University of Illinois '50) to John Deere Waterloo Tractor Works, Waterloo, Iowa.

ARCHIE G. LANE (Northrop Aero Institute '50) to Calif. Institute of Technology Co-Operative Wind Tunnel, Pasadena, Calif.

JAMES E. MOORE (Texas A and M College '50) to J. R. Spencer Co., Dallas, Texas.

Standard Tractor Connectors

Continued from Page 74

prongs be sunk in the socket and covered for protection, so that they cannot be damaged. Prongs should be self-wiping when the connector is pressed together.

Some engineers favored a mounting standardized as to spacing, so that no new holes have to be drilled for another manufacturer's mounting. Flush mountings were recommended to prevent them from being knocked off.

Most agreed that connectors should consist of two parts, with connection position easily recognized. Advantage pointed out for an irregular shape is that connections can be made in the dark. Many at the meeting felt the connector should pull apart on a 20 to 25-lb pull. Wires should be sufficiently supported to resist this pull. Corrosion resistance and easy repair and replacement were other features considered desirable in a standard connector.

Final connector requirements developed by the group will be processed through the SAE Electrical Equipment Committee for adoption as an SAE Standard. Chairman of the Subcommittee is B. G. Van Zee, Minneapolis-Moline Co.

AMS Up For Revision

THE following proposed-revised Specifications are being circulated to industry for comment and criticism by the SAE Aeronautical Materials Specifications Division:

- AMS 4424E, Magnesium Alloy Castings, Sand, AZ63, Solution and Precipitation Treated
- AMS 4434D, Magnesium Alloy Castings, Sand, AZ92, Solution and Precipitation Treated
- AMS 4500C, Copper Sheet and Strip, Annealed
- AMS 4505D, Brass Sheet and Strip, 70Cu—30Zn, Annealed
- AMS 4507C, Brass Sheet and Strip, 70Cu—30Zn, Half Hard
- AMS 4508A, Brass Sheet, Laminated, 65Cu—35Zn
- AMS 4510C, Phosphor Bronze Sheet and Strip, Spring Temper
- AMS 4520D, Bronze Strip, 4Sn—4Pb—2.8Zn
- AMS 4530B, Copper-Beryllium Alloy Sheet and Strip, Solution Treated
- AMS 4532A, Copper-Beryllium Alloy Sheet and Strip, Solution Treated Half Hard
- AMS 4544A, Nickel-Copper Alloy Sheet and Strip, Corrosion Resistant 67Ni—30Cu, Annealed
- AMS 4555B, Brass Tubing, Seamless, Light Annealed
- AMS 4558A, Brass Tubing, Seamless, 1.6FB, Drawn Temper
- AMS 4665A, Silicon Bronze Tubing, Seamless, 3.2Si, Annealed

Turn to Page 108

• AMS 4610E, Brass, Free Cutting, 3Pb —Half Hard
• AMS 4611B, Brass, Naval—Half Hard
• AMS 4612C, Brass, Naval—Hard
• AMS 4614D, Brass Forging, Free Cutting, 2Pb
• AMS 4615B, Silicon Bronze, 3.2Si—Hard
• AMS 4619B, Manganese Bronze Forgings
• AMS 4625D, Phosphor Bronze, 5Sn—Hard
• AMS 4630D, Aluminum Bronze, 8.5Al —Soft
• AMS 4631B, Aluminum Bronze, 7.2Al —1.9Si
• AMS 4632B, Aluminum Bronze, 8.5Al —Hard
• AMS 4635B, Aluminum Bronze, 10Al —3Fe
• AMS 4640B, Aluminum Bronze, 10.3Al—5.0Ni—2.8Fe
• AMS 4650D, Copper-Beryllium Alloy, Solution Treated
• AMS 4674A, Nickel-Copper Alloy, Corrosion Resistant, 67Ni—30Cu, Free Machining
• AMS 5032A, Steel Wire, Annealed, 0.18-0.23C (SAE 1020)
• AMS 5040E, Steel Sheet and Strip, Low Carbon, Deep Forming
• AMS 5042E, Steel Sheet and Strip, Low Carbon, Forming
• AMS 5044C, Steel Sheet and Strip, Low Carbon, Half Hard
• AMS 5045B, Steel Sheet and Strip, Low Carbon, Hard
• AMS 5053A, Steel Tubing, Welded, 0.08-0.13C (SAE 1010) Annealed
• AMS 5060B, Steel, 0.13-0.18C (SAE 1015)
• AMS 5070B, Steel, 0.18-0.23C (SAE 1022)
• AMS 5077A, Steel Tubing (Welded), 0.21-0.28C (SAE 1025)
• AMS 5120C, Steel Strip, 0.64-0.76C (SAE 1070)
• AMS 5121B, Steel Strip, 0.89-1.04C (SAE 1095)
• AMS 5122B, Steel Strip, 0.89-1.04C (SAE 1095), Hard
• AMS 6324A, Steel, 0.7Ni—0.6Cr—0.25Mo (0.38-0.43C)
• AMS 6325C, Steel, 0.55Ni—0.5Cr—0.25Mo (0.38-0.43C) (SAE 8740) Heat Treated (105,000 TS)
• AMS 6327C, Steel, 0.55Ni—0.5Cr—0.25Mo (0.38-0.43C) (SAE 8740) Heat Treated (125,000 TS)
• AMS 6470D, Steel, Nitriding, 1.6Cr—0.35Mo—1.15Al (0.38-0.43C)
• AMS 6480A, Steel, Nitriding, 0.65Ni—1Cr—1Mo (0.32-0.38C)

New Members Qualified

These applicants qualified for admission to the Society between Oct. 10, 1950 and Nov. 10, 1950. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Atlanta Group
C. E. Steed (A).

Baltimore Section
Charles E. Depkin (SM), W. Carroll McKenna, Jr. (M).

British Columbia Section
Daynard McCall Welsh (J).

Buffalo Section
Bernard Goldman (J).

Canadian Section
G. Hampson (A), George Kovos (M), Charles F. Shewell (A).

Chicago Section
Eugene Anton Bruha (J), Richard J. Chwalek (J), Charles H. George (J), Marshall C. Gillispie (J), Theo. B. Keller (A), Emil Kondracsek (J), George J. Magee, Jr. (M), Philip Cheslyn Mosher (J), Dean Sawyer Pierce (J), Lewis Woolsey (M).

Cleveland Section
Robert Dinda (J), Ralph R. Leo (M).

Detroit Section
Charles J. Augey (J), James John Bennett (J), David Bessie (M), W. O. Briggs, Jr. (M), Ross William Christian (J), Arthur F. Dicker, Jr. (J), Miss Helma U. Fuhrmann (A), Robert B. Hillen (J), Robert D. Holbrook (J), William Brooks McConaghy (M), Robert L. McWilliams (M), Ralph H. Mertz, Jr. (J), Robert E. Nelson (J), Sydney Rogers (J), David E. Scott (M), Robert H. Shoemaker (A), Sheldon J. Stanaway (J), Stanley J. Swanson (M), Leslie G. Taylor (M), Robert James Templin (J), Benjamin D. Thomas (J), Harris C. Thomas (M), Frank C. Wade (A), Wallace E. Whitmer (A).

Indiana Section
Norman L. Booher (J), Jerry G. Tomlinson (J).

Metropolitan Section
Leo R. Dixon (A), Edward M. Doyle (J), Louis W. Eppel (A), Eugene T. Ferraro (M), Eugene Robert Ganssle (J), George C. Giger (M), John Stevens Hammond, Jr. (A), Eric Holmgren, Jr. (M), Norman Henry Kreisman (J), Warren A. Lipman (J), Arthur Charles Mettler (A), Donald Vrooman Miller (J), Rosario O. Negri (J), M. Robert Skrokov (J), John P. Wiethoff (M).

Mid-Continent Section
Richard Lee Harned (J).

Mid-Michigan Section
Bryant Walker Pocock (M).

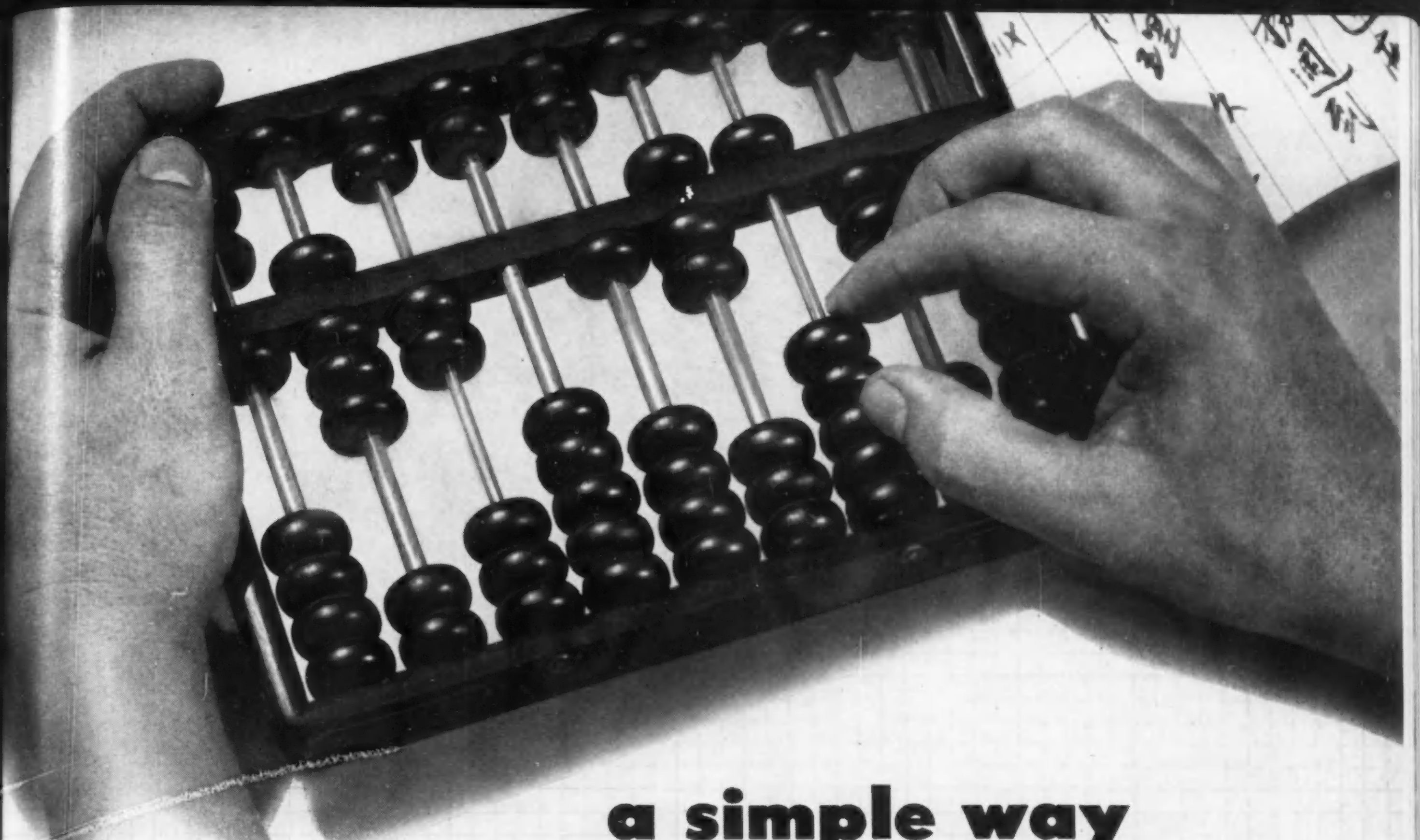
Milwaukee Section
Jay L. Bruns (J), Allison K. Simons (J), Arvid Gayle Waschek (J).

Montreal Section
A. Albert Cousineau (A), Cyril Patrick Hope Johnstone (A), Elvie Lawrence Smith (J).

Northwest Section
William N. Wentworth (J).

Oregon Section
Morris C. Anderson (A), Joseph J. Lovretich (A).

Philadelphia Section
M. Stroukoff (M), Roland Whitehurst (M).



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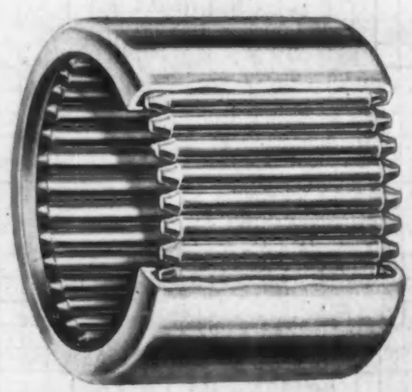

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Southern New England Section
Thomas D. Hess (J).

Spokane Intermountain Section
Lee E. Wood (J).

Syracuse Section
Harry James Donovan (M).

Twin City Section
Earl E. Melby (M).

Washington Section
Jack Henry Watters (J).

Western Michigan Section
John Carl Pataky (J).

Outside Section Territory
Frank M. Kittredge (J), Edgar Russell Lower, Jr. (J), Don J. Mathers (A), N. L. Parks (A), Elroy Penner (J), J. Rice Shellabarger (A), Major Walter Byrd Wilson, Jr. (SM).

Foreign
S. L. Balasubramanyam (J), India; Reginald Charles Greene (FM), England; Leonard Taylor (FM), England; Cecil John Williams (FM), England; David Fairweather Young (FM), So. Africa.

Applications Received

The applications for membership received between Oct. 10, 1950 and Nov. 10, 1950 are listed below.

Atlanta Group
John Evan Fears, Jr., Boyce Parkey, William F. Sadler.

Baltimore Section
William D. Fulton, John G. Worman.

British Columbia Section
Louis Frank Bonar, Joseph Scott Otis, William Fowler Otis.

Buffalo Section
Anthony J. DeFino, John A. Mattison.

Canadian Section

J. Robert Beale, John Stretton Coyne, Albert W. Evans, David Hamilton, Wilbur C. Holt, Robert Trant Ja[illegible]man, William H. Martin, Douglas Simpson, Maurice Ernst Joseph Thibodeau, Lawrence O'Connor Thompson, Frederick W. D. Welham.

Central Illinois Section

Benjamin P. Baer, Edwin R. Bredine, John M. Corkill, Donald E. DeCanniere, George M. Johnson, Arnold Martin Kaiser, Robert S. Martin, Robert T. Mees, Harold L. Ward.

Chicago Section

Michael Braudu, John J. Dreznes, William Webb Fickling, Jr., Clarence O. Goff, John G. Hallin, Leslie C. Hardison, King A. Koch, Leonard M. Kulze, Lewis C. Laderer, G. A. Lillieqvist, William C. Moore, Arthur Devere Whitmer.

Cincinnati Section

William R. Dally, Allen W. Goode, Carl M. Klatte, Kenneth M. Lamb.

Cleveland Section

Gaines M. Cook, Jr., John Dinda, Robert W. Finley, Jack A. Hart, Francis U. Hill, Jr., George F. Mullin, Laddie J. Pesek, Benjamin David Richter, Jr., Robert John Taylor, Edward J. Wissman, Joseph E. Zuber.

Colorado Group

Ira Boyd Humphreys, Walter H. Ketel, T. Allen Pelsue, E. R. Robinson, George Edgar Zeigler.

Dayton Section

Chauncey K. Haynes, Clyde A. Morgan, George F. Noltein.

Detroit Section

Stanley L. Buckay, Robert E. Champe, Arch H. Copeland, Jr., Gideon A. DuRocher, Henry H. Durr, Ralph E. Ford, W. J. Glynn, Bill Gorden, Arthur C. Hays, William F. B. Henderson, John G. Hodnicsak, Alex Hunter, William Mabrey Hutchison, Donald L. Johnson, Harold William Johnson, Edgar F. Kaiser, Anthony Lopucki, James W. MacQueen, J. F. Masden, Floyd J. McCarthy, N. P. Miller, Robert J. Offer, Sylvester Patyk, Donald Pickles, James William Pilz, David Turner Roberts, Lowell F. Sarnes, Jack G. Thom, Leslie K. Thome, Loren F. Van Nortwick, Richard L. Wheeler, Carlton Willrich, Jr., Louis C. Zimelow.

Hawaii Section

Franklin P. Gomes, Lee O. Thompson, David F. Wisdom.

Indiana Section

Laurence E. Bowen, Donald Stephen Bowman, Leo M. Darts, Keith D.

Evans, Forrest E. Hull, Arthur I. Lewis.

Metropolitan Section

John M. Ciborski, Frank Cousar, Benjamin Paul Fusco, Alexander Gee, Brice H. Hereford, Edgar Arnold Nacke, Edward John Schmidt, Harold A. Strohman, Sol Weil.

Mid-Continent Section

Warren A. Brown, Gilbert K. Ludwig.

Mid-Michigan Section

Earl L. Schaper, Leslie B. Smith.

Milwaukee Section

Darwin Tillman Anderson, Leo Earl Brinson, H. S. Jacobs, Wallace R. Johnson, Emmett Charles Manning, Herbert P. Sampe.

Montreal Section

Harold Carl Arvidson, Jr., Robert Frederick Bartlett, John Talbot Dyment, John W. Hammond, Edmund Allen Nix, Stanley S. Szczekowski.

New England Section

Stanley T. Athas, Seth E. Dunklee, John D. Mackenzie, Louis J. Palmer, Henry W. Pratt, Peter Stebbins.

Oregon Section

Jack P. Converse, Jr.

Philadelphia Section

B. Russell Cowper, Charles W. Rak, Robert Yeakel Rusling.

Pittsburgh Section

E. Newman Giles, W. B. Lenkard.

St. Louis Section

David F. Knost.

San Diego Section

Robert B. Humphreys, Harold Bond Hunting, Jr., Donald W. Tank.

Southern California Section

William Edgar Bethel, Mark J. Biondich, Edward L. Cline, E. Richard Cooper, D. L. Francisco, George S. Gregson, John T. Maddock, Gerhard Maurie, Gordon R. Steinhoff, W. Foster Word.

Southern New England Section

Richard C. Keane, William Stephen Matthews, Jr.

Syracuse Section

Charles H. Sawyer.

Texas Section

Pierre J. Gomer.

Washington Section

Clarence William Lindgren.

Outside of Section Territory

Paul C. Brunback, Ollie Wayne Chandler, Burr C. Folts, Cecil R. Jones,

Eldon Miller, Merle L. Miller.

Foreign

Richard Henry Hales, Albert Phillip Hickson, Embree Moore Kennedy.

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2. The Secretary or Assistant Secretary of your Section or Group at the addresses listed below:

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G. L. R. Baumhardt, 615 N. Ball St., Owosso, Mich.

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R. K. McConkey, 715 N. Van Buren St., Milwaukee 2, Wisconsin

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Donald Wimberly, Calif. Research Corp., 200 Bush St., San Francisco 4, Calif.

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SAE Journal

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DECEMBER 1950

PUBLISHED BY THE SOCIETY OF AUTOMOTIVE ENGINEERS

JOHNSON BRONZE

SLEEVE BEARING DATA

CAST BRONZE

JOHNSON BRONZE

SLEEVE BEARING DATA

Selecting the Alloy

The many and various applications for sleeve-type bearings make necessary the availability of a variety of bearing metals possessing many distinctly different properties. Each particular bearing metal must be best suited for those conditions of service wherein its outstanding characteristics will be of greatest advantage. Accordingly, in the selection of a bearing material it is necessary that the service conditions and the destructive forces on the bearing be analyzed first and the bearing material be then selected for each specific application.

The first step is to accumulate accurate operating data such as speeds and loads . . . whether constant or intermittent . . . method of lubrication; the presence of acid, harmful chemicals, gases, grit or dust; the type of shaft to be used.

All sleeve bearings operate in direct contact with the shaft until the creation of the necessary film of lubricant. Consequently, the following physical properties govern the suitability of a bearing metal: (1) Plasticity; (2) Ability to Resist Wear; (3) Coefficient of Friction; (4) Compressive Strength; (5) Resistance to Pounding; (6) Toughness.

While there are over one hundred bronze bearing alloys from which to make your selection, we have found through experience that the following will meet practically every application.

Johnson Bronze Alloy No	Average Chemical Composition				
	Copper Cu	Tin Sn	Lead Pb	Zinc Zn	Nickel Ni
19	70.0	11.0	19.0	. . .	. . .
25	75.0	5.0	19.0	. . .	1.0
27	80.0	10.0	10.0	. . .	. . .
29	78.0	7.0	15.0	. . .	. . .
51	87.0	10.0	1.0	2.0	. . .
53	88.0	10.0	. . . .	2.0	. . .
55	86.0	12.0	. . . .	2.0	. . .
66	85.0	5.0	9.0	1.0	. . .
71	85.0	5.0	5.0	5.0	. . .
72	83.0	7.0	7.0	3.0	. . .

Stock Size Bearings

For ordinary service applications and for quick, easy replacement Johnson Bronze maintains a stock bearing service that comprises over 850 individual sizes. This includes inside diameters from ¼″ to 4¼″; outside diameters run from ⅜″ to 4½″; lengths are available from ¾″ to 8″. All of these sizes can be quickly altered and any type oil groove, slot or hole can be economically added. Complete stocks are carried in all important industrial centers.

Engineering Service

Johnson Bronze offers manufacturers of all types of equipment a complete engineering and metallurgical service. We can help you determine the exact type of bearing that will give you the greatest amount of service for the longest period of time. We can show you how to design your bearings so that they can be produced in the most economical manner. As we manufacture all types of Sleeve Bearings, we base all of our recommendations on facts free from prejudice. Why not take full advantage of this free service?

This bearing data sheet is but one of a series. You can get the complete set by writing to—

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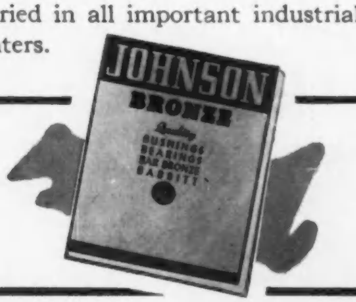


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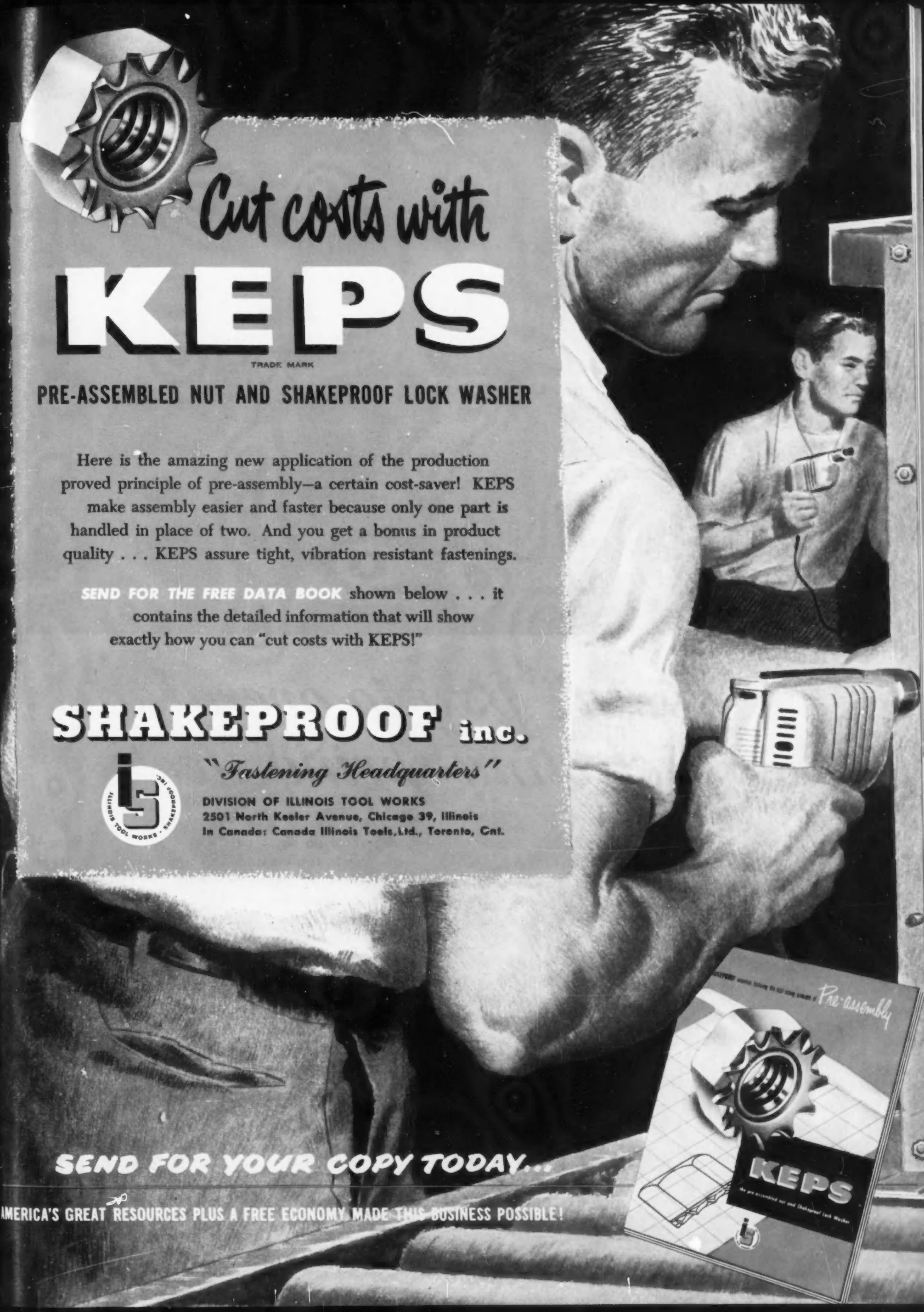
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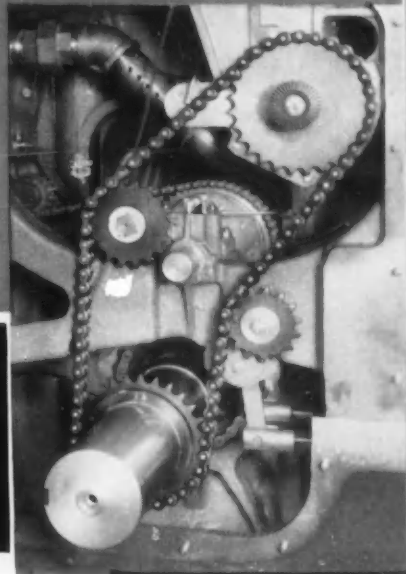
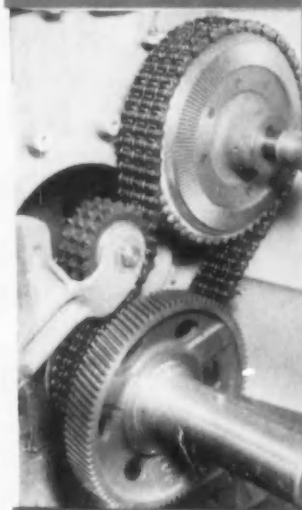


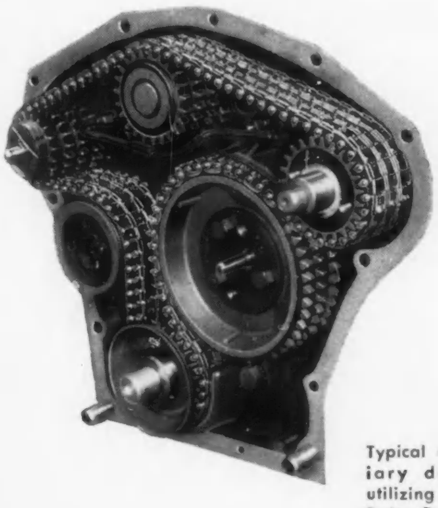
Modern design points to chain as the most efficient and convenient means of driving camshafts and other gasoline and Diesel engine auxiliaries. Flexibility of arrangement, simplicity and ease of assembly, compactness, quiet operation, long life—these are some of the more obvious advantages. Easy lubrication, inherent elasticity and shock-absorbing qualities supply added reasons for using chain.

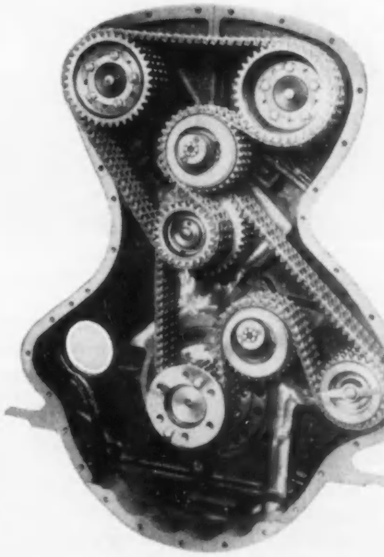
Three Link-Belt Precision Steel Roller Chains on governor and water pump drives, Model 80 Superior Diesel Engine.

Triple width Link-Belt Precision Steel Roller Chain on camshaft drive, Model 40 Superior Diesel engine.



Link-Belt Duplex Silent Chain on timing and fuel pump drive, Sheppard Model 12 Diesel Engine.





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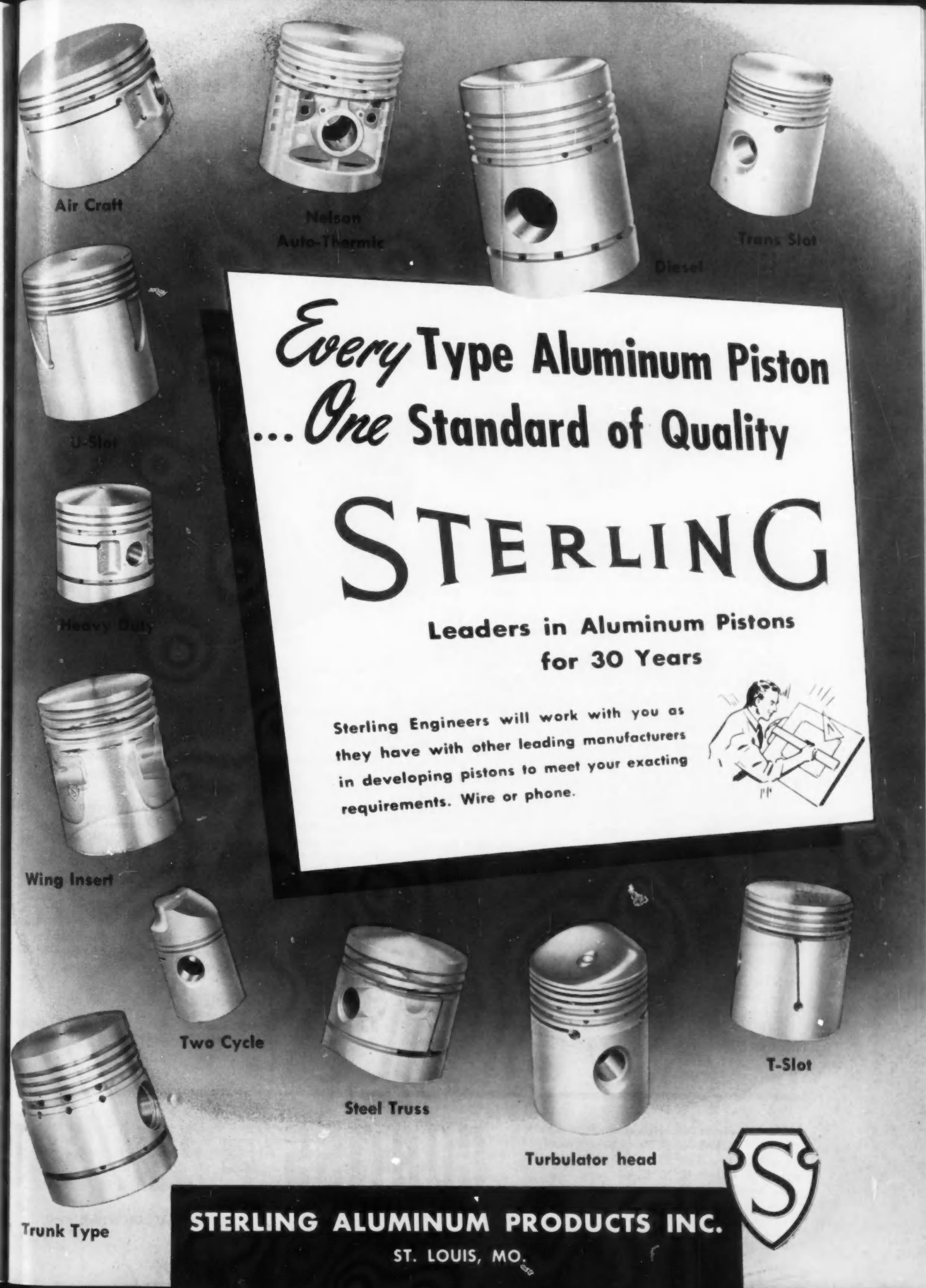
SILENT AND ROLLER TYPES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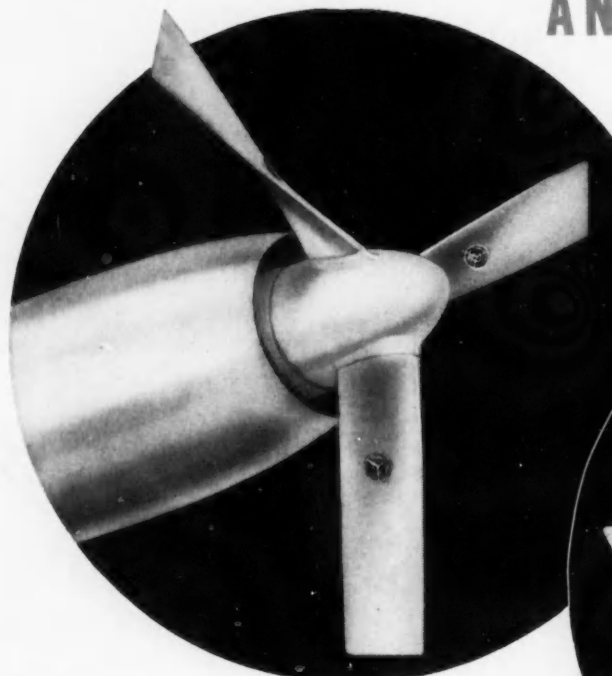

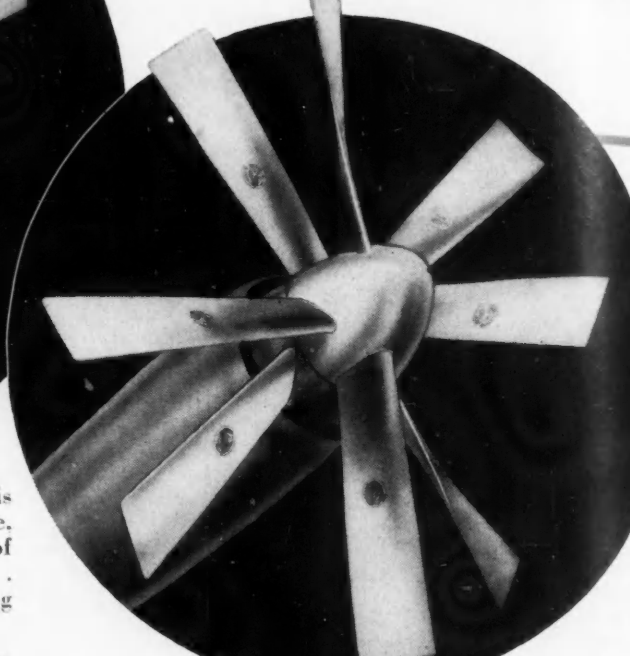

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Hollow-steel blades *of Curtiss monocoque construction backed by over 125,000,000 hours of operation in military and commercial aircraft.*

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Electrical or heated-air *de-icing.*

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